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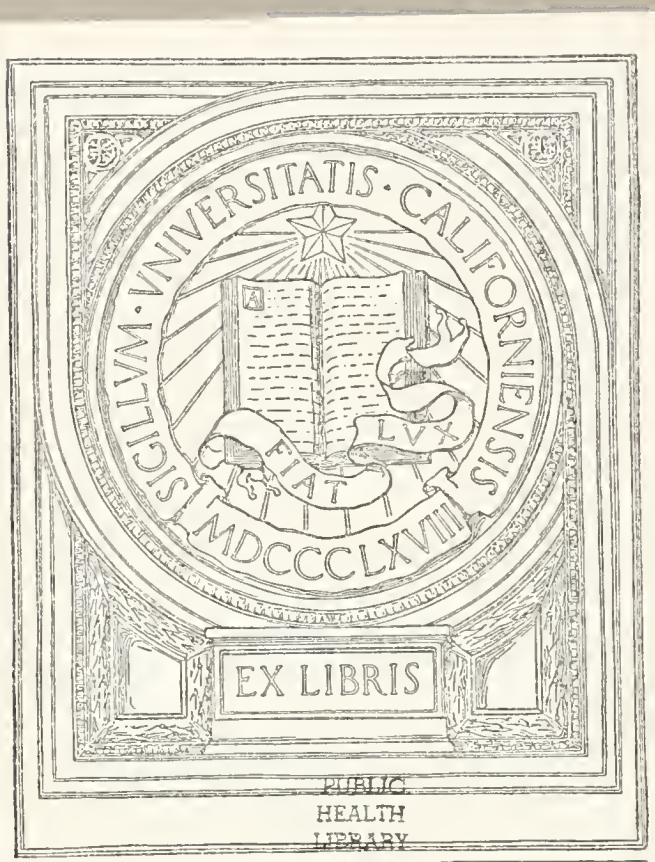

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THE EFFECT OF DIET ON ENDURANCE

BASED ON AN EXPERIMENT, IN THOROUGH MASTICATION, WITH NINE HEALTHY STUDENTS AT YALE UNIVERSITY, JANUARY TO JUNE, 1906

BY

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NEW-HAVEN, CONNECTICUT
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I.—The Effect of Diet on Endurance, Based on an Experiment with Nine Healthy Students at Yale University. January–June, 1906.

Introduction.

There appears to be very little literature on the subject of endurance. Since the epoch-making work of Mosso, much has been written on fatigue, and many varieties of ergographs have been constructed to record muscular fatigue; but no systematic study of endurance as such appears to have been made. Even the concept of endurance, as related to strength and fatigue, has been lacking. No correlations have been worked out between endurance and the factors upon which it depends, except that it has been a matter of common experience that endurance increases with exercise. In respect to diet, opinions as to its relation to endurance, so far as the writer knows, have rested on no better foundation than the personal impressions of adherents of special dietary systems, such as those of Salisbury, Dewey, Haig, Kellogg, and Fletcher. In Professor Chittenden's painstaking study on "Physiological Economy in Nutrition" he has shown that one result of a gradual and systematic reduction in proteid, from the amount ordinarily consumed, has been an increase in *strength*, but no data were obtained in respect to *endurance*.

The present experiment had a somewhat accidental origin. I was engaged in collecting statistics of labor-power in relation to various factors, among them especially diet. The data were collected because of their economic bearings and without any intention at first of making independent experiments. But some of my students, whom I had engaged to make computations and diagrams, became interested in the material with which they thus came in contact, and expressed a strong desire to try dietetic experiments upon themselves. Not being a physiologist, I asked Professor Chittenden if he could not take charge of these experiments for them. It so happened that on account of other similar work he was unable to do so, but suggested that I should conduct them myself. I have done so with considerable hesitation, not being equipped for physiologic studies. I have therefore restricted my attention to the simpler practical aspects of the problem, although some of the technical points have been inves-

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tigated through the very kind coöperation of able colleagues. My thanks are especially due to Professor Chittenden and his co-workers, Professor Mendel and Dr. Underhill, for the aid rendered by the Sheffield Scientific School Laboratory in determining the nitrogen excreted, and for much helpful advice and criticism. I wish also to express my obligations to Dr. J. P. C. Foster for his services as medical adviser to the students ; to Dr. W. G. Anderson, Director of the Yale Gymnasium, and his corps of assistants, through whom the endurance tests were conducted ; to Professor Rettger for fecal tests ; and to the subjects of the experiment themselves, Messrs. Bauer, Edwards, Lagerquist, Lawton, Mitke, Parmelee, Reeds, Taylor, and Weyman, whose patient submission to the painful tests of endurance was little short of heroic.

In January, 1906, the students above mentioned organized themselves into an eating club. The experiment began with an endurance test on January 14, and consisted of two main parts, each of which lasted about ten weeks.

The object of the first half of the experiment was to test the claims which have been made by Mr. Horace Fletcher, as to the effects upon endurance of thorough mastication combined with implicit obedience to appetite. Our conclusion in brief is that Mr. Fletcher's claims, so far as they relate to endurance, are justified.

Mr. Fletcher's method may be briefly [1] expressed in two rules.

1. *Mastication.* Thorough mastication of all food up to the point of involuntary swallowing, with the attention directed, however, not on the mechanical act of chewing, but on the tasting and enjoyment of the food ; liquid foods to be sipped and tasted, not drunk down like water. There should be no artificial holding of food in the mouth beyond the time of natural swallowing, even if, as is to be expected at the start, that swallowing is premature. It is not intended to "count the chews," or hold the food forcibly in the front of the mouth, or allow the tongue muscles to become fatigued by any unnatural effort or position, or in any other way to make eating a bore. On the contrary, every such effort distracts one from the natural enjoyment of food. Pawlow has shown that without such attention and enjoyment of the taste of food, the secretion of

[1] The reader who desires to pursue the subject is referred, as to mastication and instinctive eating, to Higgins, *Humaniculture*, Stokes, N. Y., 1906 ; as to proteid, to Chittenden, *Physiological Economy in Nutrition*, Stokes, 1904 ; and as to the general subject, to Horace Fletcher, *The A. B.–Z. of our own Nutrition*, Stokes, 1903.

gastric juice is lessened. The point of involuntary swallowing is thus a variable point, gradually coming later and later as the practice of thorough mastication proceeds, until the result is reached that the food remains in the mouth without effort and becomes practically tasteless. Thus the food, so to speak, swallows itself, and the person eats without thought either of swallowing or of not swallowing it; swallowing is put into the same category of physiological functions as breathing, which ordinarily is involuntary.

2. *Following instinct.* Never to eat when not hungry, even if a meal (or more than one, for that matter) is skipped. And when a meal is taken, not to be guided by the quantity of food offered, or by past habit, or by any theories as to the amount of food needed. The natural taste or appetite is alone consulted, and the subject selects, from the food available, only those kinds and amounts which are actually craved by the appetite. After practice, the appetite gradually becomes more definite and discriminating in its indications.

These two rules—thorough mastication and implicit obedience to appetite—were alone employed during the ten weeks which constituted the first half of the experiment.

Shortly after the beginning of the second half of the experiment, there was an interim of six days at Easter recess, during which the few men who remained in New Haven took advantage of the temporary absence of the cook to try the possibilities of living without one entirely. During this brief period use was made not only of raw foods, such as fruits, nuts and milk, but also of foods which could be purchased already cooked, such as the flaked breakfast foods. But all the food was cold, and several of the men found it cheerless and unsatisfactory. Judging from their feelings, they were losing in weight and vigor. This part of the experiment was too brief, however, to justify any reliable conclusion as to the virtues of a raw, or rather a cookless, diet.

The second half of the experiment lasted about nine weeks. The same two rules which were employed during the first half were continued during the second, but a third rule was added. This was the use of suggestion, as follows:

3. *When instinct is in doubt, use reason.*—This rule consists of acquiring and applying a little knowledge of foods and food elements. For this purpose, in the present experiment two lists of food were given. One was arranged in a tentative order of intrinsic merit, beginning with fruits and ending with alcohol, and the other in

the order of the proportion of proteid. The men were then asked, when and only when the appetite was *entirely willing*, to choose the better and purer foods and the low proteid foods in preference to those high in proteid. In this way the men gradually shifted their diet upward in the two lists, and thereby pursued a little faster the same direction in which they had already been found to be unconsciously moving under the influence of thorough mastication and implicit obedience to appetite.

It would too greatly lengthen this report if any attempt were made to repeat in detail all the specific advice given to the experimenters under Rule 3. What has been said covers in a general way all the points except the advice (subject always to the consent of appetite) to eat light and quickly digested suppers in order to go to bed on an empty stomach.

Careful record of the amounts of food eaten and the constituents of proteids, fats and carbohydrates was kept for each man each day, certain days being omitted if for any reason the record was incomplete, as when, for instance, the men were out of town or took their meals away from the club.[1] To avoid weighing at the table, the food was all weighed in the kitchen and served in "standard portions" of 100 calories each, or simple fractions or multiples thereof, and the men merely recorded the number of portions eaten. The proportions of proteids, fats and carbohydrates were found by means of the writer's "Mechanical Diet Indicator."[2] Atwater and Bryant's tables were used as a basis for calculation. For the first few weeks the figures were probably subject to some errors, and in all cases more or less guessing had to be practiced with reference to the amount of lean and fat of meats; but the influence of any errors on the results must necessarily be small, because meat supplied, at the highest, only a small fraction of the total calories. It is believed that the results are in general correct to two significant figures.

For the first two weeks of the first half of the experiment, the men ate in their ordinary way. During the following eight weeks they masticated more thoroughly and followed the leadings of taste more carefully. Most persons, while nominally following taste, are largely

[1] The number of days each week on which the record of diet was kept was seldom under six.

[2] For a description of this instrument, see the writer's "A New Method of Indicating Food Values," *American Journal of Physiology*, April, 1906. For a description of its practical uses see "A Graphic Method in Practical Dietetics," *Jour. of the Amer. Med. Assoc.*, Apr. 20, 1907.

controlled in their selection of foods by many other circumstances,—as, *conventionality*, or the desire to eat what others eat and the unwillingness to appear "different"; *politeness*, the desire to please one's host and hostess; *food notions*, the opinion that certain foods and certain amounts of food are "wholesome" even if not palatable and that certain foods should be avoided as injurious even if delicious to the taste; *narrowness of choice*, as at a boarding house table, which often supplies what is not wanted and withholds what is; and *habit*, by which the particular kinds and amounts of foods which have become customary through the previous causes—conventionality, politeness, food notions, and narrowness of choice—are repeated day after day without thought. The subjects of the present study were given a wide range of choice, the menu including fruits, nuts, cereals, puddings and pastry, vegetables, milk, meats, etc. Meat if desired was available three times a day.

The object of the experiment was to find what effects on diet and endurance would follow from a strict obedience to the taste-instinct, when this instinct was given a longer chance to act by prolonged mastication and attentive tasting. Each man was therefore encouraged to choose his own food out of the menu for the day. Nothing was set before him until it was ordered, and even after a food was ordered it was not eaten if taste did not so dictate. The men were specially warned, during the first half of the experiment, against any conscious effort to decrease their food, proteid, or meat; and while it is possible that subconscious suggestion played a part, so far as could be observed they were freer from its influence than any ordinary experimenter who might take up the same experiment after reading Mr. Fletcher's or Professor Chittenden's books.

That this conclusion as to the relative absence of subconscious suggestion is correct was evidenced by the experiences both before and after this part of the experiment. For a month prior to its actual beginning (Jan. 14), the experiment had been fully decided upon, and its plan and scope understood by the men. Had subconscious suggestion played an important rôle, it would probably have shown itself in a reduction of proteid during this month; but determinations of the grams of nitrogen daily excreted in the urine, taken at the beginning and end of this month, indicated no substantial change, as the following table shows. (M. does not appear in this table, owing to the absence of any specimen for December.)

TABLE I.

	B	E	Lq	Lw	P	R	T	W	Average
Middle Dec.	11.2	11.1	13.8	12.3	11.3	13.9	14.2	15.9	13
Middle Jan.	10.4	12.7	14.3	14.3	11.1	14.8	12.2	15.4	13.1

On the other hand, during the second half of the experiment (Mar. 28–June 1), when the force of suggestion was consciously introduced, the reduction of flesh and proteid went on rapidly, as is seen in Table II. The facts, therefore, seem to show that the men followed directions closely, avoiding largely the influence of subconscious suggestion and following that of conscious suggestion in exact accordance with the directions given them.

Changes in Diet.

During the first two weeks of the first period when no change of habits was undertaken, the food showed little tendency to change in amount or in kinds. On the other hand, for the remaining eight weeks, during which thorough mastication and instinctive eating were practiced, there was a distinct though gradual tendency toward reduction in the amount of food, in the quantity of proteid, in the quantity of flesh foods, and in the quantity of liquids of all kinds—water, tea, coffee, cocoa, and even soups. Exact figures were kept for calories, proteid and flesh foods. These showed that the total calories gradually fell about 10%, the proteids, 15%, and the flesh foods, 40%.

In the second period, during which the force of suggestion to reduce proteid and flesh foods was added, the same effects were noted in a still greater degree. During this period the calories dropped nearly 20%, the proteid over 25%, and the flesh foods about 70%. Comparing the diet at the close of the entire five months of the experiment with the diet at its beginning, it was found that the total calories had fallen about 25%, the proteid about 40%, and the flesh foods over 80%, or to about one-sixth of their original amount. A part of the reduction, at least of the calories, is probably due to the change in season, as the experiment began in cold weather and closed in hot weather.

These results are shown in the following table :

TABLE II.

AVERAGE DIETETIC RECORDS OF ENTIRE CLUB

	Week	Average weight	Average no. of "portions" daily	Calories of proteid per lb. of body wt.[1]	Daily "portions" of flesh foods
1st Period	Jan. 17–23	149.8	28.3	2.7	2.4
	24–30		30.3	2.6	2.1
	31–Feb. 6		27.8	2.5	1.6
	Feb. 7–13		27.6	2.4	1.2
	14–20		25.8	2.1	.9
	21–27		26.4	2.2	1.1
	28–Mar. 6		25.3	2.2	1.2
	Mar. 7–13		24.6	2.1	1.3
	14–20		25.9	2.2	1.1
	21–27	148	26.7	2.2	1.4
2nd Period	28–Apr. 3		26.7	2.1	.8
	Apr. 4–10		25.7	1.9	.5
	11–17[2]		27.3	1.7	.4
	20–26[3]		26.1	1.7	.1
	27–May 3		25.5	1.9	.5
	May 4–10		25.7	1.9	.4
	11–17		26.2	1.9	.4
	18–24		24.9	1.7	.4
	25–31		22.2	1.4	.4
	June	144			

Remembering that a "portion" is 100 calories, we see that, during the first four weeks, the men consumed an average of from 2760 to 3030 calories per day, of which 120 to 240 were in the flesh foods, such as meats, poultry, fish and shell-fish, and that 2.4 to 2.7 calories of proteid were ingested for each pound of body-weight. Translating Professor Chittenden's figures for the physiological requirement of ingested proteid, we find it to be from 1.3 to 1.7 calories per pound of body-weight. Thus the men were at this time consuming nearly double the Chittenden allowance. During the last four weeks of the experiment all these magnitudes were lower. The per capita calories ranged from 2220 to 2620, of which only 40 were in flesh foods, and the proteid had fallen to 1.4 to 1.9 calories per pound of body-weight, which corresponds closely to the Chittenden standard.

Table II was constructed from the following three tables giving separate data for the individual experimenters.

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[1] This column is calculated throughout on the basis of the body-weights on Jan. 14.

[2] Except E., M. and P.

[3] Except E. The last two days of the Easter recess, Apr. 18, 19, are omitted in tables II, III, IV, V.

TABLE III.

DAILY QUANTITIES OF FOOD

(in "portions" of 100 calories each).

	Week	B	E	Lq	Lw	M	P	R	T	W	Average
1st Period	Jan. 19–23	25.4	26.1	22.4	32.6	23.9	27.0	32.0	36.1	29.4	28.3
	24–30	27.9	29.1	24.3	32.6	26.8	26.2	34.5	37.3	33.9	30.3
	31–Feb. 6	26.3	26.4	25.0	29.8	24.4	23.8	30.9	30.8	33.0	27.8
	Feb. 7–13	25.7	27.8	25.7	31.3	22.0	23.2	28.0	32.8	31.6	27.6
	14–20	24.0	32.4	24.0	26.1	21.6	20.3	25.1	29.2	29.4	25.8
	21–27	23.0	30.9	23.4	28.3	24.5	18.2	26.7	30.3	32.2	26.4
	28–Mar. 6	23.3	25.7	23.6	27.4	24.1	18.0	25.4	29.1	30.8	25.3
	Mar. 7–13	23.2	23.0	24.5	27.4	26.4	19.2	23.5	23.7	30.1	24.6
	14–20	21.9	21.6	24.5	29.1	30.2	20.8	25.0	30.8	28.9	25.9
	21–27	21.1	24.2	25.2	31.6	25.9	21.2	26.5	34.4	30.4	26.7
2nd Period	28–Apr. 3	22.6	26.3	26.2	27.5	25.2	23.0	26.1	33.5	30.2	26.7
	Apr. 4–10	24.2	24.2	24.6	27.7	22.5	22.5	26.2	30.5	28.7	25.7
	11–17	24.0	....	26.0	24.9	....	....	29.0	30.4	29.8	27.3 [1]
	20–26	26.5	....	24.1	24.5	23.6	23.3	25.5	32.0	29.4	26.1 [2]
	27–May 3	25.5	22.6	25.4	24.8	24.1	24.4	23.9	29.0	29.8	25.5
	May 4–10	23.0	25.5	26.5	24.4	27.1	23.1	26.0	28.7	26.7	25.7
	11–17	21.8	19.2	26.5	27.6	24.5	23.8	27.6	30.3	34.2	26.2
	18–24	22.7	19.1	23.7	27.8	19.5	25.4	24.6	26.5	35.2	24.9
	25–31	19.3	17.2	23.6	27.1	17.8	21.9	24.2	20.3	28.6	22.2

From this table we see that there were wide differences between the men in regard to the change in the quantity of food. During the first period the men who reduced their calories conspicuously were B., P. and R., the very men, as Table IX will show, who lost weight during this period.

During the second period, reductions were noticeable in E., Lw., M. and T. These, together with B. and P., were the men who lost weight during the second period. We see here a distinct correlation between quantity of food and loss of body-weight.

TABLE IV.

PROTEID (in calories) PER LB. OF BODY-WEIGHT

(Body-weight as taken Jan. 14, 1906)

	Week	B	E	Lq	Lw	M	P	R	T	W	Average
1st Period	Jan. 17–23	2.6	2.9	1.8	2.8	2.6	2.8	2.5	3.3	2.7	2.7
	24–30	2.5	2.8	2.2	2.8	2.7	2.5	2.5	3.0	2.8	2.6
	31–Feb. 6	2.2	3.1	2.4	2.9	2.5	2.0	2.3	2.7	2.6	2.5
	Feb. 7–13	2.1	2.9	2.2	2.6	2.0	2.1	2.0	2.9	2.6	2.4
	14–20	2.0	3.1	1.8	2.0	1.9	1.7	1.8	2.7	2.2	2.1
	21–27	1.8	3.2	1.9	2.3	2.0	1.5	1.9	2.8	2.4	2.2
	28–Mar. 6	1.8	3.0	1.8	2.3	2.4	1.5	1.8	2.6	2.4	2.2
	Mar. 7–13	1.9	2.5	2.0	2.3	2.5	1.7	1.7	2.1	2.6	2.1
	14–20	1.9	2.3	1.9	2.5	2.7	1.7	1.9	2.8	2.4	2.2
	21–27	1.6	2.6	2.0	2.7	2.4	1.7	1.9	2.7	2.2	2.2

[1] Not including E., M. and P.

[2] " " E.

TABLE IV—*Continued.*

PROTEID (in calories) PER LB. OF BODY-WEIGHT

(Body-weight as taken Jan. 14, 1906)

	Week	B	E	Lq	Lw	M	P	R	T	W	Average
2nd Period	Mar. 28–Apr. 3	1.8	2.6	2.0	2.2	2.2	1.9	1.8	2.7	2.2	2.1
	Apr. 4–10	1.5	2.9	1.7	2.0	1.7	1.5	1.8	2.4	1.8	1.9
	11–17	1.2	..	1.8	1.7	..	..	1.7	1.9	1.9	1.7
	20–26	1.8	..	1.6	1.6	1.7	1.5	1.5	2.3	1.6	1.7
	27–May 3	1.7	2.5	1.7	1.7	2.0	1.7	1.6	2.2	1.8	1.9
	May 4–10	1.6	3.0	1.9	1.9	2.2	1.4	1.8	2.1	1.5	1.9
	11–17	1.6	1.9	1.7	1.9	1.9	1.6	1.9	2.1	2.0	1.9
	18–24	1.5	1.8	1.4	1.7	1.8	1.6	1.6	1.7	2.1	1.7
	25–31	1.1	1.3	1.5	1.6	1.6	1.2	1.7	1.4	1.5	1.4

We observe from Table IV that the men who reduced their proteid the most during the first period were B., P., R., T. and W. Of these the first three only lost weight appreciably, and this was partly ascribable, as we have seen, to reduction in their calories. Careful examination of the figures would seem to show, however, that there is some correlation between reduction of proteid and loss of weight.

During the second period there was a decided reduction of proteid in all cases except that of R., who had already brought his proteid down considerably in the first period. E. reduced his proteid, but not until the last three weeks, when he seemed to try to make up for lost time. E., in fact, was the only man in the club, except possibly M. who (through mere inadvertence) did not follow out the rules of the experiment systematically. It need scarcely be said that this is not stated as censure; for the very fact of the moderation of E.'s and M.'s mastication added to the value of the final comparisons. Even E.'s sudden reduction in proteid at the end was not maintained two weeks afterward, as was shown by the excretion of nitrogen in June, given in Table VI.

It will be observed that the proteid at the end of the experiment was reduced to a fairly uniform level for all the men. Moreover, the proteid at the end corresponds closely with the results of Professor Chittenden's experiments. This is especially significant in view of the fact that this level was reached unconsciously—for only one of the men, Lq., who used the mechanical diet indicator for the entire club, knew regularly the exact character of each man's food proportions—and without any food prescription as was employed in the experiments of Professor Chittenden. This means that there is a simple way of reducing proteid to the level of "physiological econ-

omy," open to the ordinary man, without the necessity of special knowledge of foods and without the necessity of weighing and measuring food, either by the subject himself or by others.

Aside from the changes in proteid, the proportions of food elements did not vary greatly, the percentages of fat and carbohydrate in the total fuel value remaining very nearly constant. At the close of the experiment it was found that for all of the men the proteid in proportion to the total fuel value was very nearly 10%, having been reduced from about 14%. This reduction in the percentage of proteid was almost entirely offset by the increase in the percentage of fat, which rose from about 30% to about 33% on the average. The percentage of carbohydrate thus remained almost constant. Individual variations were much less than might have been expected. The proteid at the close of the experiment among the different subjects deviated very little from 10%; the proportion of fat varied from 28 to 36%, and the carbohydrate from 51 to 62%.

The results of the experiment may throw some light on the problem of the proper amount of food and food constituents for healthy men eating in a natural manner. For the five men, Lq., Lw., M., R. and W., whose weights showed least tendency to fall and whose average weight at the close of the experiment was 151.4, we find the average total calories were 2620, of which 10.7% was proteid, 33% fat, and 56.3% carbohydrate. The number of calories agrees closely with the estimates (for sedentary persons) of Atwater and Benedict by means of the calorimeter.

TABLE V.

QUANTITIES OF FLESH FOODS CONSUMED (meat, fish, shell-fish; poultry)

(In "portions" of 100 calories each).

	Week	B	E	Lq	Lw	M	P	R	T	W	Average
1st Period	Jan. 17–23	2.7	2.4	1.5	2.6	2.4	2.6	2.3	2.9	2.1	2.4
	24–30	2.2	2.2	1.7	2.0	1.8	2.2	2.1	2.1	2.2	2.1
	31–Feb. 6	1.3	1.9	1.2	2.1	1.6	1.3	2.1	1.9	1.4	1.6
	Feb. 7–13	1.3	1.6	.9	1.7	.6	1.2	1.5	1.8	1.2	1.2
	14–20	.9	2.3	.2	1.1	.7	.9	.9	1.6	.5	.9
	21–27	1.2	2.0	.2	1.6	.6	.7	1.6	2.1	.6	1.1
	28–Mar. 6	.8	2.1	.3	1.5	1.1	1.1	1.6	1.5	.8	1.2
	Mar. 7–13	.7	1.6	.1	2.4	1.0	1.2	1.9	1.6	.9	1.3
	14–20	1.0	1.7	.03	1.9	.9	.7	1.8	1.5	.7	1.1
	21–27	1.0	2.5	.0	2.5	1.7	.7	1.2	2.5	.6	1.4

TABLE V—*Continued.*

QUANTITIES OF FLESH FOODS CONSUMED (meat, fish, shell-fish, poultry)

(In "portions" of 100 calories each).

	Week	B	E	Lq	Lw	M	P	R	T	W	Aver.
2nd Period	Mar. 28–Apr. 3	.9	1.7	.0	1.7	.6	.8	1.1	.8	.1	.8
	Apr. 4–10	.4	1.1	.0	1.0	1.0	.1	.7	.8	.0	.5
	11–17	.1	--	.0	.9	--	--	.8	.7	.0	.4
	20–26	.0	--	.0	.1	.1	.0	.2	.4	.0	.1
	27–May 3	.16	1.2	.0	.6	.8	.2	.9	.5	.0	.5
	May 4–10	.0	.9	.0	.8	.8	.0	.5	.6	.0	.4
	11–17	.0	1.2	.0	.7	.8	.0	.4	.3	.0	.4
	18–24	.0	1.3	.0	.5	.5	.0	.8	.2	.0	.4
	25–31	.0	1.0	.0	1.0	.9	.0	.8	.4	.0	.4

Table V shows that during the first period all except E. and Lw. reduced their consumption of flesh foods considerably. It is noteworthy, as Tables XI–XIII will show, that these two were the men whose improvements in endurance were probably among the least during this period.

During the second period Lq., W., P. and B. virtually abandoned flesh foods entirely, the "portions" consumed daily averaging nearer zero than .1. These men improved greatly in endurance also. On the other hand, E., Lw., M. and R. reduced their flesh foods the least, and their ranking in respect to increased endurance was in general relatively low.

Excretions, Body-Weight, Strength.

The following table of nitrogen excreted in the urine is interesting in connection with the preceding table. It will be seen that the reduction in nitrogen daily excreted corresponds in general to the reduction in proteid consumed.

TABLE VI.

GRAMS OF NITROGEN EXCRETED DAILY.[1]

	B	E	Lq	Lw	M	P	R	T	W
Middle Jan.	10.4	12.7	14.3	14.3	8.7[2]	11.1	14.8	12.2	15.4
First April	6.6	14.7	9.2	11.1	---	6.3	11.6	12.4	9.0
Middle June	6.3	13.1	8.4	---	13.7	6.1	---	8.8	9.4
N. in middle June per kilog. of body-weight	.093	.22	.12	---	.21	.09	---	.12	.13

[1] Each figure is obtained by averaging 2 or 3 consecutive days' specimens.

[2] Jan. 23 and Feb. 10.

This table shows that all the men excepting E. and M. greatly reduced their nitrogen excretion during the experiment, and that at the close (with the two exceptions noted) the men were on about the same nitrogen level as the subjects of Professor Chittenden's experiment, namely, near one-tenth of a gram of nitrogen per kilogram of body-weight.

Through the kindness of Professor Benedict of Wesleyan University, nitrogen analyses were made in December, 1906, six months after the close of the experiment, to discover to what extent the men had adhered to their newly acquired diet after the eating club in which it had been practiced was disbanded. The results were B. 11.0, Lq. 10.5, Lw. 7.9, M. 9.9, P. 6.8, R. 11.5, T. 11.9, W. 8.9. These show that half of the men had reverted to some extent toward their original diets. The men state that the reason for this reversion was the difficulty in selecting food differing greatly in kind and amount from that customarily served at their boarding houses.

The following table shows that the volume of urine daily excreted was greatly reduced during the experiment :

TABLE VII.

VOLUME OF URINE DAILY EXCRETED (in cubic centimeters)

	B	E	Lq	Lw	M	P	R	T	W
Middle Jan.	1425	1160	1130	1391	817[1]	706	1287	1792	1177
First April	630	985	900	1252	....	629	1025	930	797
Middle June	802	1120	822	....	785	480	....	696	970

From this table we see a striking reduction in the volume of urine excreted, with the same two notable exceptions, E. and M. These two, who reduced their excretions least, were the men who were the least assiduous in observing the rules of the experiment.

A careful examination of the feces was made by Professor L. F. Rettger of the Sheffield Scientific School. A summary of his report follows. In it was included a comparative statement for three sets of specimens of two days each, taken in January, March and June, referred to below as series I, II and III. These included data as to the color, odor, quantity, consistency, approximate determination of the number and predominant kinds of bacteria, putrefactive and fermentative properties, and a true microscopic bacterial examination. In brief, to quote from Dr. Rettger's report and letter :

[1] Jan. 23 and Feb. 10.

"The odor was very slight in almost every specimen in the last series, a marked difference between these and series I and II, particularly I. The average weight is less than in both series I and II (av. wt. of series I = 137.3 grams; of II = 164.8 grams, and III = 120.4 grams).

"The figures indicate considerable difference in the putrefactive and fermentative properties of the three series, and the decrease is progressive. In series I the amount of proteid dissolved was much larger than in II and III. . . The specimens [of series III] were more solid generally than in both previous series. I was unable to note any appreciable difference in the microscopic appearance of the last series as compared with the previous, except that in specimen B of the last series a large number of moulds were present. This has little significance, however."

TABLE VIII. FECAL TESTS[1]

	Putrefactive Degree			Fermentative Property		
	Mid. Jan.	End March	Mid. June	Mid. Jan.	End March	Mid. June
B	?	?	8%	+ +	+	+
E	30%	25%	10%	+ +	+	+
M	20%	10%	15%	+	+	+
Lq	60%	?	50%	+ +	+	+
Lw	25%	15%	†	+ +	+	†
P	20%	?	?	+	—	—
R	30%	20%	†	+ +	+	†
T	20%	?	5%	?	+	+
W	30%	10%	5%	+ +	+	+

We here observe that the degree of putrefaction in the last two tests was usually considerably less than its magnitude in the first test. The least change in the feces occurred in the cases of Lq., M. and E., and the greatest changes in P., T. and W. Here again we find some correspondence between the assiduity of the men and the observed physiological changes; for E. and M. were the least and P. and W. the most careful among the experimenters.

A critic has raised the question whether the improvement in the feces indicates lessened absorption of poisons, and whether, if the feces were longer retained, the improvement in their character might not be in consequence of the abstraction from them and absorption

[1] In the table, " + " signifies the presence and " — " the absence of fermentative property; " + + " represents a high degree of fermentative property; " ? " signifies that the putrefactive degree was doubtful, if not absent.

† No specimen.

into the system of a *larger* amount of poisons. The length of time of retention of the feces was not measured in any way. So far as can be guessed from the impressions of the men, it was not lengthened, certainly not greatly, as in the case of Mr. Fletcher.[1] As to the significance of the improvement in feces, Dr. Rettger writes :

"The subject of intestinal putrefaction is one of which very little is as yet known. A retention of feces may have the tendency of lowering the amount of putrefactive products. This is due, I believe, to two things : first, an absorption of such products as indol and mercaptan ; and second, an unusual amount of antagonistic action exerted on the evil-producing (putrefactive) bacteria by the ordinary and presumably helpful bacteria. Recent work seems strongly to emphasize the latter point. . . There is nothing to show that a small degree of retention would make a very great difference.

"The absence of appreciable amounts of putrefactive bodies from feces under the ordinary conditions of peristalsis does, beyond a doubt, indicate a lessened production of the products (toxines) ; the system must be the better off on account of this . . . the interpretation of the facts must be dealt with rather cautiously."

The following table shows the body-weights of the men (after deducting weight of clothing).

TABLE IX.

BODY-WEIGHTS IN POUNDS (without clothing)

	B	E	Lq	Lw	M	P	R	T	W	Average
Jan. 14	148	127	147	153	141	144	179	156	153	149.8
Mar. 28	144	128	147	154	142	136	176	155	151	148
June 16	138	122	146	149	138	131	175	148	149	144

We see that during the first period, the weights, except of P., remained practically stationary, but that in the second period all of the men lost somewhat in weight, though the loss was trifling in most cases. The only substantial losses during the two periods combined were : P. 13 lbs., B. 10 lbs., and T. 8 lbs. Of these it may be said that B. was distinctly over his normal weight at the start.

The distinct correlation between the loss of weight and the reduction in food, and to some extent in proteid, has already been noted. P.'s loss is ascribable largely to overstudy. The general slight reduction in weight of the entire club is probably explained in the same way, for all the men, with possibly two exceptions, distinctly overstrained

[1] See *The A. B.-Z. of our own Nutrition.*

in their college work. Besides the influence of overwork, there was also present the influence of the season,—at least if the common impression is correct that persons usually lose weight with the approach of warm weather.

Gymnasium tests were made at the beginning, middle and end of the experiment. These tests were of two kinds,—tests of strength and tests of endurance. The times of the tests were widely separated, partly because those of endurance were too exhausting to be often repeated, and partly because it was desired to avoid the influence of "practice"; for not only does practice increase strength and endurance, but it also gives the users of the strength-registering apparatus a facility or "knack" in manipulating it which produces a false appearance of improvement.

The dates of the three tests were January 14, a week after the end of the Christmas vacation; March 28, just before the Easter recess; and June 16,[1] just before the summer vacation.

Tests of strength, taken at the beginning, middle and end of the experiment, show the following effects:

TABLE X.

STRENGTH TESTS (in lbs.)

	Date	B	E	Lq	Lw	M	P	R	T	W	Average
R. Grip	Jan. 14	100	135	95	98	145	95	132	120	125	116
	Mch. 28	93	130	110	100	112	102	127	130	117	113
	Jun. 16	91	130	110	92	105	103	125	121	115	110
L. Grip	Jan. 14	94	115	82	112	107	82	131	95	127	105
	Mch. 28	82	115	110	100	105	70	115	106	111	102
	Jun. 16	75	115	97	105	105	70	125	98	110	100
Back Lift	Jan. 14	275	400	280	340	375	250	360	370	365	335
	Mch. 28	260	440	375	380	275	275	390	400	400	355
	Jun. 16	280	300	290	250	330	265	345	330	364	306
Leg Lift	Jan. 14	520	600	370	400	460	320	820	545	635	519
	Mch. 28	515	600	455	450	410	415	865	570	650	548
	Jun. 16	400	545	440	445	400	300	610	520	650	479
Total	Jan. 14	989	1250	827	950	1087	747	1443	1130	1252	1075
	Mch. 28	950	1285	1050	1030	902	862	1497	1206	1278	1118
	Jun. 16	846	1090	937	892	940	738	1205	1069	1239	995

In this table we see that during the first period there was a slight increase in strength (from an average "total" strength of 1076 to 1118), and during the second period a slight fall to 995, which is about 12% from the mid-year's 1118, and about 8% from the original

[1] But May 31 for E., Lw., R. and W., on account of earlier examinations than the others, necessity to leave town, etc.

1076. Thus the strength of the men remained nearly stationary throughout the experiment. The greatest losses were those of B., E. and R., whose records fell respectively from 989 to 846, 1250 to 1090, and 1443 to 1205.

The loss of strength, like the loss of weight, seems most probably explainable by the overstudy of the men. This cause was certainly actively at work, and would apply in the case of all of the club with possibly two exceptions. Overstudy applied conspicuously to B. and R., both of whom not only overworked during the entire period of the experiment, but had, just before coming to the last test, been through the most exhausting and sleep-robbing week of all. There seems, therefore, little reason to ascribe any part of the slight losses of strength to the dietetic experiment itself.

This opinion is confirmed by two facts : One is that the man who was least affected dietetically by the experiment was E., one of the three largest losers of strength, while the men who were most affected dietetically were P. and W., neither of whom lost strength perceptibly, in spite of P.'s severe overwork and loss of weight. The other fact is that in Professor Chittenden's experiment, which dietetically was very similar, the subjects, who were soldiers and athletes and not subject to pressure of work of any kind, showed large gains in strength. From these two facts we may infer that, so far as the diet is concerned, the effect would be to increase rather than to decrease strength.

Changes in Physical Endurance.

It is fortunate that the strength of the men remained so nearly stationary ; for it demonstrates the more clearly that the increase in endurance which will be shown below was an increase in endurance *per se*, and not in any degree due to an increase in strength. Strength and endurance are entirely distinct and should be separately measured. The strength of a muscle is measured by the utmost force which it can exert *once* ; its endurance, by the number of times it can repeat a given exertion *well within its strength*.

After much consideration and consultation it was decided not to place reliance on the ordinary ergographs as a means of measuring endurance.[1] Instead, seven simple gymnastic tests of physical endur-

[1] The reasons, in brief, were (1) because these ergographs are adapted to testing only a few unimportant, and for the most part unused, muscles ; (2) because, in operating these devices, the subjects do not simulate real work, since the mus-

ance were employed, and one of mental endurance. The seven physical tests were :

(1) Rising on the toes as many times as possible.

(2) Deep knee-bending, or squatting as far as possible and rising to the standing posture, repeating as often as possible.

(3) While lying on the back, raising the legs from the floor to a vertical position and lowering them again, repeating to the point of physical exhaustion.

(4) Raising a 5-lb. dumb-bell (with the triceps) in each hand from the shoulder up to the highest point above the head, repeating to the point of physical exhaustion.

(5) Holding the arms from the sides horizontally for as long a time as possible.

(6) Raising a dumb-bell (with the biceps) in one hand from a position in which the arm hangs down, up to the shoulder and lowering it again, repeating the motion to the point of physical exhaustion. This test was taken with four successive dumb-bells of decreasing weight, viz., 50, 25, 10 and 5 lbs. respectively.

(7) Running on the gymnasium track at a speed to suit the subject, to as great a distance as possible.

The mental test consisted of adding specified columns of figures as rapidly as possible, the object being to find out whether the rapidity of performing such work tended to improve during the experiment.

From the wisdom born of experience it may be stated that the physical tests were too numerous and too severe. But after they

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cles are placed in an awkward and unnatural position in which "no purchase" is felt ; (3) because experience has shown that subjects waste their effort by expending it not only while raising but while lowering the weight, and that this waste during the period of relaxation varies greatly with different subjects ; (4) because a fixed weight is used instead of a weight proportionate to the different strengths of the various subjects. One might as well attempt to test the walking powers of a woman weighing 100 lbs., as compared with those of a man weighing 200 lbs., by compelling the woman to carry a 100-lb. weight so that she might walk with the same weight as the man. Some of these objections have been met in special instruments, such as that of Prof. W. S. Hall of Northwestern University.

After the experiment was half over, and too late to make use of it, the writer devised an ergograph which, it is believed, meets all of the above objections. He was led to do so by the fact that the tests employed were so frightfully exhausting to the men. A description of the new ergograph will be published later. It is to be employed in further tests.

were once adopted in January, it was necessary in subsequent tests to adhere to them, so far at least as always to begin with the same test and follow the same sequence of tests as far as the series was repeated. It is clear that one's ability to succeed in an individual test would depend greatly on what and how many tests had immediately preceded; consequently the only modifications in the January tests which could legitimately be adopted in March consisted in omitting all tests after the first two or three. These first two or three, being taken under the same conditions as before, reflected correctly any change in endurance so far as those particular tests were concerned.

At the final series of tests in June, no omissions from the January program were made; to save time, however, the last two parts of test 6, together with test 7 (which came at the end for all the men), were repeated only up to the point at which they had been carried in January, although the men were able in June to carry them much further, and in many cases did so of their own accord. One man, for instance (W.), who in the run in January was glad to stop at 10 laps, went on in June to 34, running at the same speed until near the end; and this was done after having more than doubled his former records in almost all of the other tests. The unlooked-for increase in endurance made the June tests much more time-consuming than the tests in January and March. Had the men in June taken test 7, and the two last parts of test 6 up to the same fatigue limit as in January, some of them would have had to remain in the gymnasium (supperless) until bed time. One of the men, who in January in the last two parts of test 6 raised the 10-lb. dumb-bells 318 times and the 5-lb. dumb-bells 1,863 times, without doubt could have raised them in June double and probably treble these numbers, but to have done so would have consumed of itself an hour and a half of extra time.

In view, therefore, of the only partial repetition of test 7 and the last two parts of test 6, these records are omitted from Table XI. The first part of test 6 (lifting the 50-lb. dumb-bell) is also omitted, being given separately below.

The following table (XI) shows the results of the three sets of tests in January, March and June.[1] This table will repay careful study.

[1] The order in which the tests were taken was not the same for all of the nine men, owing to the lack of a sufficient number of gymnasium assistants in taking the tests. But care was taken that each man should himself preserve the same order in all three series of tests. Thus, for the March series he took the first two

From it we see that with one exception (E.) all of the men had improved in the March and June tests as compared with the January tests, and the eight men who did improve showed improvement in every test, except Lq., Lw. and T., who showed slight falling off in individual cases.

As inspection will show, some of the increases are remarkable. The recorded increases in the 60 odd cases were, with a few exceptions noted below, all true increases and not due to increased effort to break a previous record. In anticipation of such possible effect of ambition, the men were urged in the January tests to the utmost limit they could or would stand. The original intention had been to work each muscle tested until it was physically unable to repeat the motion, but this was not usually found practicable, except in tests 3, 4 and 6, and in some cases 2. In the other tests the will gave out before the muscles. The March and June tests were so managed that when a man had surpassed his January record he was not allowed to proceed beyond the degree of fatigue which he had reached in the first test. This was usually not a difficult matter, as the fatigue in January had been excessive and the men had no desire to suffer again the painful after-effects. Hence, with the exceptions to be noted, the March and June records not only exceeded those of January, but were accomplished with much less fatigue. The actual improvement was therefore greater than the recorded improvement.

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or three tests which he had taken in January. This explains why, in the March series, the tests as shown in the tables are not the same for all the men. The order of the January and June tests for the different men is given below. The tests which were taken in March are in italics.

B	*1*	2	3	4	5
E	*1*	2	3	4	5
Lq	*1*	*2*	*4*	3	5
Lw	*1*	*2*	*3*	4	5
M	*1*	*5*	2	3	4
P	*3*	1	5	2	4
R	*1*	2	3	4	5
T	*1*	2	3	4	5
W	*3*	*5*	1	2	4

TABLE XI.

TESTS OF PHYSICAL ENDURANCE.

			B	E	Lq	Lw	M	P	R	T	W
(1)	Rising on Toes	Jan.	300	1007	333[1]	69[1]	127	1482	702	900	1263
		Mar.	400[2]	1265[2]	2620[4]	65[1]	400[7]	----	831[2]	1500[4]	----
		June	500[2]	1061[7]	3000[5]	85[1]	1500[4]	1800[2]	1263[2]	1800[3]	3350[5]
(2)	Deep Knee Bending	Jan.	82	142	70	48	132	208	374	129	404
		Mar.	---	---	191[7]	47[7]	---	---	---	---	---
		June	200[2]	81[7]	202[2]	58[7]	155[2]	230[2]	453[7]	250[4]	508[4]
(3)	Leg Raising	Jan.	25[6]	52[6]	9[3]	22[6]	30[6]	27[6]	50[6]	23[3]	30[6]
		Mar.	---	---	---	33[6]	---	34[6]	---	---	40[6]
		June	33[6]	38[6]	20[6]	35[6]	31[6]	37[6]	103[6]	19[6]	53[6]
(4)	5-lb. Dumb-bell (triceps)	Jan.	75[6]	138[6]	78[6]	38[6]	51[6]	44[6]	100[6]	83[6]	185[6]
		Mar.	---	---	106[6]	---	---	---	---	---	---
		June	127[6]	59[6]	80[6]	51[6]	75[6]	56[6]	104[6]	101[6]	501[6]
			M S	M S	M S	M S	M S	M S	M S	M S	M S
(5)	Holding Arms Horizontal	Jan.	5- 0	1-33	4- 7	3-37	3-30	5-39	2- 5	3-22	11- 0
		Mar.	----	----	----	----	5-49	----	----	----	15-35
		June	9-36[6]	2-56[7]	3-50[7]	3- 0[7]	6- 5	10-1[2]	3-16[7]	3-24[7]	23-45[7]
(6)	25-lb. Dumb-bell (biceps)	Jan.	50[6]	18[6]	16[6]	6[6]	20[6]	11[6]	10[6]	25[6]	54[6]
		June	105[6]	10[6]	26[6]	33[6]	30[6]	29[6]	27[3]	75[3]	108[3]

Criticism of Records of Physical Endurance.

That the fatigue after the March and June tests was in general much less than after the January test was made evident by three substantial proofs. The first was the feelings of the men themselves as recorded in the foot-notes to Table XI. After the March and June tests, every man of the eight who showed improvement felt "not tired," or "less tired than in January test," which is the same as saying "not exhausted"; or else he had gone "to limit" as in January, which means that the muscle itself refused to continue work. The last was usually true of the "leg-raising," "raising 5-lb. dumb-bell (triceps)" and "raising 25-lb. dumb-bell (biceps)". The only tests in which there was the possibility of being mistaken as to the degree of fatigue were the "rising on toes" and "holding arms horizontal." In the former fatigue comes so slowly, and in the latter the pain is so intense that they prove to be tests of will power or "grit" quite as

[1] Cramped.

[2] Not as tired as in January test.

[3] Not to limit.

[4] Not nearly as tired as in January test.

[5] Not tired.

[6] To limit of muscle's capacity.

[7] About same fatigue as in January.

much as of muscle power. In these cases the men had some difficulty in remembering the original degree of fatigue. But the increases were so great and the men were so positive as to their feelings that there remains little room to doubt the substantial correctness of the results. In a few other individual cases, as of Lw. and Lq., whose records in test 1 were sometimes stopped by cramps, there is some room for doubt as to the correctness of the recorded improvement.

The second proof that the fatigue of the men in the June tests was less than that in the January tests was found in the fact that the stiffness and soreness which followed in June were markedly less than in January and of much shorter duration. This was true of all the eight men who showed improvement, except R.

The third proof of less fatigue in June than in January for the eight men is that in June the men finished the ordeal of the endurance tests with more strength left than in January, although, as we saw from Table X, they *began* the two tests with slightly less strength. The fact that they had more strength left after the June test is made evident by the first part of test 6, given below, which in each case came after the endurance tests were nearly or quite finished. This consisted in lifting a 50-lb. dumb-bell. The weight being so great, this was practically a test of strength rather than of endurance. Now all of the eight men who showed improvement in the *endurance* tests of Table XI, showed improvement in this *strength* test also, as the following table shows:

TABLE XII.

LIFTING (by biceps) 50-lb. DUMB-BELL. [1]

	B	E	Lq	Lw	M	P	R	T	W
Jan.	0[3]	1[3]	1[3]	0[3]	1[3]	0[3]	4[3]	2[3]	13[3]
June	1[3]	0[3]	5[3]	8[3]	13[3]	1[3]	10[3]	12[2]	26[3]

But, as we have seen in Table X, the strength tests taken *before* the endurance tests showed a slight falling off in June as compared with January for all but one (Lq.) of these eight men. In other words, in June the men *began* their endurance tests weaker than in January, but *finished* them stronger. The larger residuum of strength

[1] This part of test 6, being one of strength rather than of endurance, was not included in the endurance Table XI. Had it been included it would have increased even more the percentage of improvement shown, for it shows an average increase from 2.4 to 8.4, or 250%.

[2] Not to limit.

[3] To limit of muscle's capacity.

left after the June tests as compared with the January tests indicates that the June tests, in spite of being far more severe, fatigued the men less.

The 50-lb. dumb-bell test resolved the last doubts in my own mind whether, for some of the men, the recorded results might not exaggerate the true improvement. The two men of whose records I should have felt a little doubt were B. and R. Both of them came to the June test after prolonged mental exertion, and their exhaustion at the end was far more evident than that of any of the others. That it was great is clear from their own statements given below, though only R. reported himself as having been about as stiff and sore after the June as after the January tests. But both B. and R., whereas they had less strength (Table X) before the June endurance tests than before the January tests, had more strength left (Table XII) after the June tests than after the January tests. At the close of the January tests they were so exhausted that B. could not raise the 50-lb. dumb-bell at all and R. could raise it only 4 times. Had their exhaustion after the June tests been as great, it seems certain that B. would still have been unable to raise it, and R. would have been unable to raise it more than 4 times; but as it was, B. raised it once and R. 10 times.

The value of such a positive proof that the June tests were more easily endured than those of January was not perceived until the figures were analyzed. Had it occurred to me in time, all the strength tests taken before the endurance tests would have been repeated after them. It is true that the strength tests at the beginning were not of the same muscles as those (the biceps) used in the strength test by dumb-bells at the end, but, as Table X shows, the strengths of different muscles for the most part vary in unison with each other.[1]

It is significant that the only man whose strength, as shown by the above table, was less at the close of the June experiment than at the close of the January experiment was E., who was also the only man whose endurance showed any reduction. The facts, therefore, in his case are not discordant with those already stated; for, as has been stated, E. was the least assiduous in following the experiment. This was

[1] Out of the 108 comparisons of strength (i. e., comparisons for each of nine men in each of four tests for January vs. March, March vs. June, and January vs. June), only 20 are discordant with the general trend as shown by the totals. Thus, for B. the general trend between March and June as shown by the total was downward, and this downward trend is found in all but one of his four tests the discordant case being the "back lift."

often remarked, both to him and to me, by the other members of the club, and it was suggested more than once that I should "nudge" him. But, as I had been desiring a "control," or a subject in which all the conditions except mastication were the same as for the other men, I decided to say nothing. The result was instructive, for E.'s case stood out as exceptional in almost all respects. His reduction in quantity of food (Table III), except for a spurt at the end, was less than of most of the men; his reduction in proteid (Table IV), with the same exception, was the least of all; his reduction in quantity of flesh foods (Table V) was the least of all; his nitrogen in June (Table VI) was one of the highest; his reduction in volume of urine (Table VII) was one of the lowest two; his improvement in the fecal tests (Table VIII) was third to lowest; his loss of strength (Table X) was second greatest; and as to endurance, he was the only one who failed to show improvement.

There was only one other man, M., who was thought, though in a smaller degree, to masticate less carefully than the experiment called for; and for him we find corresponding peculiarities, though in a smaller degree. Thus, his reduction in total daily food (Table III) was less than of most of the men; his reduction in proteid (Table IV) was less than the average reduction; his reduction in flesh foods (Table V) was the third smallest; his June nitrogen was the highest (Table VI); his reduction in quantity of urine (Table VII) was one of the lowest two; his improvement in fecal test (Table VIII) was second to lowest; his loss of strength (Table X) was the third greatest (or fourth, if measured in percentage); and his increase in endurance, though great, was (except in test 1, which is subject to some doubt) less than the average.

The shortcomings of these two men, E. and M., as to mastication were not intentional, but due to carelessness and force of habit, as well as, in the case of M., to the fact that he waited on table and felt naturally more pressed for time. Their experience is valuable in showing that, in a general way, the changes in diet and endurance were proportionate to the thoroughness of mastication and the following of natural appetite.

The men kept diaries in which are recorded their sufferings after the various tests. These show a decided lessening in stiffness and soreness in the later tests, though in the June tests the men had generally done double the amount of work that they had done in January. It would have been a physical impossibility to do as much in January as was easily accomplished in June in tests 3, 4 and 6; and granted

that it had been even possible in January to goad the men to do as much in tests 1, 2 and 5 as they did without urging in June, they must certainly have been ill.

The following are statements from the men themselves :

Personal Impressions at end of Experiment.

(B) I was *very sore* [after the June test, Saturday, June 16, 1906]. However, I think the soreness was not so severe or lasting as it was after the January test. The muscles of my right arm were swollen considerably and I was unable to straighten it for two or three days. But the swelling was not so severe as it was after the earlier test and the arm was much more usable. The muscles of the thighs were the sorest ; they were nearly worn out. During Sunday, Monday and Tuesday after the test I had difficulty in walking ; and going down stairs was quite a difficult and severe undertaking. Wednesday morning the soreness had not left, though it had decreased considerably. I took a considerable tramp that day, and by night I could scarcely feel the soreness at all. By Thursday I had practically regained my normal endurance ; walked six or seven miles that day. The calf-muscles too were quite sore, but much less so than after the January test. There was another particular distinction. After the earlier test the calf-muscles were hard and knotted for several days ; but this time, while they were sore, they were almost normally soft. Saturday evening when I went to bed they were quite hard, but Sunday morning they were normal and practically remained so. . . .

I have no doubt that in my case there was great increase in endurance, though I think that I lost in amount of energy that I could exert at any given moment. This loss is due perhaps to two things ; (1) I took, on the whole, less exercise than during the time preceding the January test ; (2) I had been working quite hard for three months steadily, while the January test followed a three weeks' vacation during which I did little or nothing. As to increase of endurance there can be no doubt. For example, in the deep knee-bending, I began to get tired at 50 and had no idea of going above 100. When I reached this I set my goal at 125, then 150, 160, and was able to reach 200 before I was exhausted. In January, after I was tired I was not able to go on very long before I became completely exhausted. This shows increased endurance. I had the same experience in the other hard physical tests. In case of the run, I was sure I could not go more than three laps after my first lap ;

but I made 11 or 12 and could have gone several more. Considering everything, I have no doubt that I was able to hang on much longer, after I began to get tired, than in January.

I am at a loss to ascribe the increased endurance to anything else than to the diet. My way of living otherwise continued about the same after the January test as it was before. . . . Personally I am convinced that the increased endurance must be due to diet and manner of eating; all other factors that I can think of are unfavorable rather than favorable to more endurance. I am convinced to the extent that I shall certainly continue "Fletcherizing" and using a low-proteid diet.

(E) All effects of [June] test disappeared entirely within four days. [Effects of January test lasted six days.]

(Lq) The stiffness and soreness had entirely disappeared in four days. It was not nearly so severe as the test in January. After I was through in January I could hardly go down the stairs of the Gymnasium, and three days after the test going up and down stairs was accompanied with a great deal of pain. . . . I was stupid mentally for a whole week the first time, but in the last test I passed that stage in a couple of days. . . . Had it not been for the late hours and long stretches of work, I should have been able to make a better comparison with conditions in January, though as it was results show improvement. . . .

I cannot say as to the help mentally I have derived, for I have, always gone to my limit and I would be unwilling to make any positive statement. As for the physical, I know there is an improvement there, for my stomach, which was never so very strong, has been greatly helped.

(Lw) There was no stiffness or soreness felt in the triceps or the stomach muscles as the result of the last tests. The thigh muscles were a little stiff on the second day only—about such stiffness as one might expect from a long walk. The calves of my legs began to stiffen on Friday [June 15, 1906, the day after the test] and continued to do so on Saturday, after which the stiffening began to lessen, and was scarcely felt on Monday. The biceps of my right arm gave me the most trouble. These were sore on Friday A. M. and continued to increase in soreness till Sunday evening, feeling worst, however, Sunday A. M. When I arose Monday A. M. all the soreness and stiffness had disappeared. A peculiarity about the latter which impressed me was the fact that although my arm was very sore it did not seem to be very stiff. After the tests in January I could not

straighten my arm, but I could after the last tests in spite of the extreme soreness. I had entirely recovered by Monday from the tests. At no time after the tests did I feel any pain in proceeding up and down stairs, and if I remember rightly I couldn't say the same in January; neither did I feel particularly uncomfortable at any time. After the half-mile run and the lifting tests which I took later, I felt no soreness or stiffness afterward. . . .

I think the credit must be given to the diet experiment. I have worked harder from January to June than ever before, and have taken less exercise. As my mental work was so different from that previous, I cannot form an estimate of any increase or decrease in efficiency, but as I have said before, I always rested up more quickly. During the spring I have not felt that "all gone feeling" which usually has appeared in the past. The diet which we have had has relieved me of the sour stomach after meals, and I have felt better and worked harder on less exercise than ever before. . . . After a moderate amount of exercise, I have felt no such stiffness as used to come.

(M) The stiffness and soreness were entirely worn off in two days. I did not feel it nearly as much as I did last January. In fact, I did not exert myself to the utmost this last time because I had several examinations to take a day or two later.

My general impression is that the experiment was an all around benefit to me. I fully believe that during the tests, they reflected the true state of the case in showing my efficiency in June compared with that in January. I believe that there was a decided improvement in efficiency and could ascribe it partly to my exercise and the other part to the new manner of eating. I believe, however, that my exercise played a very small part because I think what I gained in exercise I lost in sickness [mumps].

My exercise this year was practically the same as years preceding. After April 1st I had very little exercise, on account of the mumps. This left me in a weak condition over a month. I had lots of work to make up and studied harder from April to June than any other period of my course. My exercise was neglected these three months and I studied almost constantly every day and until 12 at night.

My experience has shown me that I was at my best in mind and body when I ate meat four times a week. I have tried both more and less and found the above to be the medium. I also found that I could do more when I had the largest meal at noon. The greatest benefit of the experiment to me personally is that last year I broke down in the spring term and this spring I kept up my work and health in a much better condition.

(P) I went into the second test with some trepidation, knowing that I had lost considerable weight the preceding ten weeks. . . . Physically, I cannot say that I felt stronger before the second test than before the first; nor did I feel weaker. As the test developed, however, I soon saw that my endurance, both mental and physical, had increased.

Generally speaking, the soreness was less extensive, less trying or acute, and (I think) shorter-lived than in January. . . . It seems to me, as I finished the test much fresher than in January, a clear gain in efficiency is proven. The test seemed certainly to make a true report. . .

I can ascribe gain in endurance to nothing but the diet and thorough mastication. Every other factor in the situation was against this gain—exercise, of which I took certainly no more than usual and in the latter weeks much less; work, of which I had had a long, hard pull as against the three weeks' rest preceding the January test; sleep, much decreased for most of May and June. You stated last December that you wished every factor to be *in favor* of the first test and *against* the second. This condition has been true in high degree for my case. . . Whatever the efficacy of the two tests in proving the superiority of low proteid and thorough mastication for the other members of the club, I feel convinced that they prove that superiority with considerable force in my own case.

I have tried meat and chicken a number of times in the last two weeks, partly from curiosity and partly from necessity. But in every case anticipation has been pleasanter than realization, and my low-proteid tendencies bid fair to remain for some time to come. I may say that I had no opinion on the diet question when the experiment started, but am now a hearty low-proteid exponent. . .

I went into the test with considerable foreboding as to my endurance showing; for I have worked now without a break for twenty-two weeks at hard mental labor, the last two weeks being especially confining and involving large losses of sleep and exercise. I may say that I have been unusually well for six or eight weeks, and bowels have been running with greater ease and constancy than for several years. . . The endurance-tests, showing a good increase in every test, consequently came as a complete surprise; and my self-confidence, largely absent at the start, returned in increasing measure as the test went on. . .

Thursday, June 21 [5 days after test]. Played golf this morning and afternoon (9 holes each time) with perfect ease, no difficulty

with walking or driving the ball. Soreness wholly gone at present writing, no touch of it noticeable anywhere.

(R) The outcome of the last endurance test was about the same as the one held January 14, 1906. I was fearfully sore for about one week, reaching the climax at the middle of the week.

(T) Throughout the test I passed from one event to another with much shorter periods between than I did in January. With the exception of lying on my back and raising my feet, I at no time approached as near exhaustion as I did in January. In January, in rising on my toes and in the deep knee-bending, I continued till I fell to the floor. I was not exhausted at the close [of the June test], but marked papers for 2½ hours before going to bed. Sunday I scarcely felt any the worse, though my muscles felt a little queer when I poked my finger into them. Monday my leg muscles were a little stiff after a period of rest, but not painful in the least. My right shoulder was a trifle lame, due wholly I think to hitting it once in a while in the last test with the 10 and 5-lb. weights. My right arm at the elbow was decidedly lame and would not admit of being completely straightened, though it was undoubtedly better than in January. By Tuesday all the other stiffness had practically left me except the right elbow, which was, however, better. By Thursday I was unable to detect any soreness whatever in any part.

(W) May 31. After the test I felt fairly tired and ready to quit —however, not nearly so exhausted as before in January. Could walk down stairs with more confidence and could raise my supper to my mouth much more easily than after the first test. . . . The results certainly far surpassed any expectation I had, especially as in the morning I did not feel quite as spry and active as usual, due to a little unusual over-exertion the previous day.

June 1. Sore in thighs and biceps, also felt my abdominal muscles.

June 2. Expected to be much worse on this the second day, as in January, but not so. About same as yesterday. Later in the day could run up-stairs two steps at a time as I could yesterday—a thing undreamed of in January for over a week after the test.

June 3. Felt pretty well today, much improved over yesterday, still felt my thighs in walking down hill or down stairs, but not nearly as bad as yesterday.

June 4. Feel my thighs only very little, other muscles not felt at all. Rode a bicycle 5½ miles ; did not feel it.

June 5. Seem to be all well, haven't noticed a soreness all day.

The following table expresses the percentage of improvement in the records of Table XI.

TABLE XIII.

IMPROVEMENT IN PHYSICAL ENDURANCE IN PERCENTAGES.

		B	E	Lq	Lw	M	P	R	T	W
(1)	Jan.–Mar.	33+	26±	686–	–5±	215±	---	18+	66+	---
	Jan.–June	66+	5±	800–	23±	1081±	21+	79+	100+	165+
(2)	Jan.–Mar.	---	---	172±	–2±	---	---	---	---	---
	Jan.–June	144+	–43±	188+	21±	17+	10+	21±	94+	26+
(3)	Jan.–Mar.	---	---	---	50	---	26	---	---	33
	Jan.–June	32	–27	122–	59	3	37	106	–17	77
(4)	Jan.–Mar.	---	---	36	---	---	---	---	---	---
	Jan.–June	69	–57	2	34	47	27	4	22	170
(5)	Jan.–Mar.	---	---	---	---	66±	---	---	---	42±
	Jan.–June	92–	89±	–7±	–17±	74±	77+	56±	1±	115±
(6)	Jan.–June	110	–44	62	450	50	163	170	200	100+
Av.	Jan.–Mar.	33+	26±	298±	14±	140±	26	18+	66+	37±
	Jan.–June	85±	–13±	194±	95±	212±	56+	73±	66±	109±

In the preceding table most of the figures are succeeded by a "+", which signifies that the true improvement was greater than the figures indicate. Thus, the first entry in Table XIII, "33+", means that B.'s improvement between January and March in test (1) (rising on toes) was *more* than 33%. Similarly, "686–" for Lq. in same test means that improvement was *less* than 686%. Again, "215±" for M.'s same test signifies that his improvement in this test may have been greater *or* less than 215%. Finally, when any figure is not followed by a sign, as for instance, B.'s (3) (leg raising), the meaning is that the figure given is, humanly speaking, correct. This accuracy applies only to those tests in which the muscles were worked till they were physically unable to repeat the movement. The reasons for the various suffixes may be found by studying the foot-notes of Table XI.[1]

[1] For instance the "+" after 33 for B.'s (1) is explained by the fact (as indicated in the foot-note to Table XI) that after his March test he was not as fatigued as after his January test, although he had improved upon his January record by 33%. The only cases in which the explanation of the suffixes will not be found from the foot-notes to Table XI are the following: E.'s (1), 26±, in which case the "—" is inserted owing to the fact that E. had come to the March test after the refreshment of a nap; and M.'s (1), 1081±, in which case the "—" is inserted owing to the fact that this high figure is inconsistent with the other results of the test, it being thought that M. may have been mistaken in his

The table shows enormous differences in the figures even of the same man for the same period. Thus, the June improvement of W. reads 165+, 26+, 77, 170, 115±, 100+. Such wide differences between the improvements in different tests seem puzzling at first, but they are explained, partly if not wholly, by two reasons. The first is the obvious one that many of the figures are not exact records, but understatements, and naturally their margin within the truth will vary widely. Thus, the records for deep knee-bending (2) for W. show merely that the improvement is *over* 26%; the true figure may well be 100%, which would be more consistent with the other figures. But the deep knee-bending test had been found in January very painful and inconvenient in its after-effects, and there was therefore less inclination in the June tests to approach closely to the limit in this particular test.

The other reason is that in some tests a larger fraction of the total strength of the muscle tested was called into play than in others. Thus, "leg raising" requires a very large fraction of the strength of the abdominal muscles, while "rising on toes" requires only a small fraction of the strength of the calf muscles. This may explain why, in general, the improvement in the test of the calf muscles seemed so much greater than in that of the abdominal muscles. This explanation is, however, purely hypothetical. It would be interesting to find out experimentally how much an improvement in the endurance of a muscle shows itself when it is exerted in different degrees, say to 75%, 50% and 25% of its strength-capacity.[1]

Bearing in mind these two possible reasons for the variations in the figures, and also the fact that there must have been more or less actual differences in the improvement of different muscles, we need not be surprised at the disparities which the table shows.

If we omit the cases in which the records are at all doubtful (with suffix ±) or exaggerated (suffix −), we have left the following table for the eight men who showed improvement :

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remembrance of his January test. The "−" has been inserted whenever there was the slightest ground of any kind for thinking the figures might be overstatements. With these figures weeded out, the remaining ones certainly understate the actual improvement.

[1] The original object of using the graded dumb-bells, 50-lb., 25-lb., 10-lb., and 5-lb., for testing the biceps, was to throw light on this problem ; but for reasons previously stated, these tests were not fully carried out.

TABLE XIV.

PERCENTAGE OF IMPROVEMENT (exact or understated) OF EIGHT MEN.

		B	Lq	Lw	M	P	R	T	W
(1)	Jan.–Mar.	33+	---	---	---	---	18+	66+	---
	Jan.–June	66+	---	---	---	21+	79+	100+	165+
(2)	Jan.–Mar.	---	---	---	---	---	---	---	---
	Jan.–June	144+	188+	---	17+	10+	---	94+	26+
(3)	Jan.–Mar.	---	---	50	---	26	---	---	33
	Jan.–June	32	---	59	3	37	106	–17	77
(4)	Jan.–Mar.	---	36	---	---	---	---	---	---
	Jan.–June	69	2	34	47	27	4	22	170
(5)	Jan.–Mar.	---	---	---	---	---	---	---	---
	Jan.–June	---	---	---	---	77+	---	---	---
(6)	Jan.–June	110	62	450	50	163	170	200	100+
Av.	Jan.–Mar.	33+	36	50	---	26	18+	66+	33
	Jan.–June	84+	84+	181	29+	56+	89+	80+	107+

The figures of Table XIV show an undoubted increase in endurance, both for the first half and more especially for the whole period of the experiment.

But, for an accurate presentation, we may carry our criticism one stage further. The figures given hitherto represent a conglomerate sort of endurance, made up of endurance of different muscles subject to different degrees of strain. As pointed out before, the calf muscles were called upon for only a small fraction of their strength-capacity, whereas the abdominal muscles were called upon for a very large fraction. Moreover, the fraction must have varied somewhat in different tests, according to the variation in strength and weight. An ideal test would be one in which the same fraction of strength was used.[1]

Fortunately, such an exact test is afforded by the 25-lb. dumb-bell. It followed immediately after the 50-lb. dumb-bell had been raised until the biceps was unable to repeat the motion. At the moment the 50-lb. test ended, the 25-lb. test began. At this moment the strength of the biceps was just at or barely below the fifty lbs. required to raise the heavier dumb-bell. In other words, in raising the 25-lb. dumb-bell the muscle needed *just fifty per cent.* of its strength at the time the test began. The use of the 25-lb. dumb-bell gradually reduced this strength from 50 to 25 lbs. The test was there-

[1] It is on this principle that the new ergograph, before referred to, is constructed.

fore perfectly uniform for all the men ; it showed how many contractions were necessary in each case to bring down the strength of the biceps from 50 to 25 ; it showed how much the muscle could endure before being robbed, by fatigue, of half its strength. Thus at the beginning the strength is 50 lbs.; after the first contraction it is, say, 49 ; after the second, 48, etc. But the contractions continue until the strength sinks below 25 lbs. The loss of strength may be said to measure fatigue. The *slowness* of this loss may be said to measure endurance and is well indicated by the number of contractions necessary to tire a muscle from a strength of 50 lbs. to a strength of 25 lbs.

Four exceptions, however, need to be noted. Three men, B., Lw. and P., were unable in January to raise the 50-lb. dumb-bell at all (see Table XII). Consequently their January test with the 25-lb. dumb-bell did not begin at 50% of the strength, but at a higher fraction. This explains their high apparent improvement. Thus, Lw. is credited with an improvement of 450%, because in January he could raise the 25-lb. dumb-bell only 6 times, and in June, 33 times. But the 33 contractions in June began at just 50% of the strength of the muscle, owing to its previous exhaustion to the 50-lb. level by the 50-lb. dumb-bell, whereas the six contractions in January began at a higher level; for at that time the biceps could not raise the 50-lb. dumb-bell at all. Its strength was at that time less than 50 lbs., say 40 lbs., in which case the lifting of the 25-lb. dumb-bell required not 50% but 62½% of its strength. To compare a 50% test of June with a 62½% test in January gives a record of improvement which is not one of pure endurance, but which includes the element of increased strength. This is "endurance" in the crude sense in which we may say a man has more endurance for carrying trunks than a boy ; but for a comparison of pure endurance, the boy should be given smaller trunks to handle than the man.

The fourth case is E., to whom the reverse reasoning applies. In June when he reached test 6, he was unable to raise the 50-lb. dumb-bell at all, though in January he had raised it once. Hence, while the 25-lb. dumb-bell was a 50% test in January, it was a more severe one in June, and the −44% which records his falling off does not represent a pure loss in endurance, but partly also a loss of strength. To reckon *pure* endurance we need to bring −44 up toward zero.

Making the four omissions just mentioned, we may use the remaining records from the last line of Table XIII, as a barometer of *pure* endurance.

We therefore have three methods of estimating the increase of endurance between January and June. These may be put together in the following table :

TABLE XV.

PERCENTAGE OF INCREASE OF ENDURANCE, JANUARY TO JUNE.

BY THREE METHODS.

	B	E	Lq	Lw	M	P	R	T	W
Average 6 tests	85±	−13±	194±	95±	212±	56+	73±	66±	109±
Omitting doubtful cases "+"	84+	---	84+	181	29+	56+	89+	80+	107+
"Pure" endurance of biceps	---	---	62	---	50	---	170	200	100+

The first line of this table tells us the average of the recorded improvement in endurance shown for each man. But as each such average is made up from the figures of Table XIII, some of which, as indicated in that table, are possibly too high, some doubt necessarily attaches to it, though practically the only real cases of doubt are Lq. and M. The average of these averages is 101% for the entire club, and is probably within the truth ; for most of the individual figures which go to make up this result are understatements, not overstatements.

The second line shows the average improvement in tests in which there is no doubt that the figure is at least not too high, though it may be too low. The average of these is 89%, and is therefore certainly too low an estimate of the average improvement for the eight men who improved at all.

The third line shows the increase of *pure* endurance (that is, endurance considered apart from strength) for the five men for whom the figures were available. The average of these is 116%.

We are quite safe in saying therefore that the average improvement of the eight men who improved was 90%. As to the degree of retrogression of E., it is difficult to say, though it is believed that the figures exaggerate it. This is certainly true of the 25-lb. dumb-bell test, for reasons given. My own impression, and E.'s also, is that he actually gained in endurance from the dietetic experiment, but that his gain was not enough to offset the loss occasioned by (1) the hard term's work, which, as in the case of the other men, was a decided handicap, and (2) the omission of his customary exercises, which must have

been a greater handicap in his case than in any other of the men; for he had been accustomed for six years to heavy gymnasium training, but during the year of the experiment this training was given up, largely because of the difficulty in finding time for it. If this interpretation is correct, we may liken the experiment to nine men trying to swim against a current. The eight who exerted themselves the most succeeded in forging ahead; the one who tried the least drifted backward, though the effect of the swimming (dieting) was to propel him forward. Whether or not E. was actually propelled forward by diet must remain a matter of conjecture or inference; but that the other eight men gained is an established fact.

Changes in Mental Endurance.

The mental test consisted in adding a specified number of figures. The following tables show the time during which the addition was performed and the number of errors committed:

TABLE XVI.

TIME OF PERFORMING A UNIFORM AMOUNT OF ADDITION.

		B		E		Lq		Lw		M		P		R		T		W		Average	
		M	S	M	S	M	S	M	S	M	S	M	S	M	S	M	S	M	S	M	S
Time of adding	Jan.	14	5	40	4	49	6	15	4	54	6	46	3	1	7	6	6	41	4	6	5	29
	Mar.	28	5	16	4	27	4	35	4	15	5	47	2	43	6	32	7	18	4	34	5	3
	[1] June	16	4	50	5	9	4	40	4	23	5	50	2	58	7	3	6	5	4	7	5	0

This shows that during the first period seven had improved and two had fallen off, and on an average there had been a decrease from 5m. 29s. to 5m. 3s., an average improvement of 26s. W. showed an increase in time of adding, although he would naturally have been expected to improve on account of having taken up clerical work involving adding.

During the second period there was an average improvement of only 3s.; three retrogressed 15s. to 42s., three retrogressed 3s. to 8s., and three improved 26s. to 73s. The fact that the men held their own in the June adding test is probably indicative of actual improvement, for they were fatigued mentally by examinations, etc., on the day when they entered the June test. During the entire experiment there was an average improvement of 29s.; seven had improved and two had retrogressed (1s. and 20s.)

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[1] E., Lw., R. and W. taken on May 31.

The following table shows that the number of errors committed was remarkably constant for most of the men and for the average :

TABLE XVII.

NUMBER OF ERRORS OF ADDITION.

		B	E	Lq	Lw	M	P	R	T	W	Average
Errors	Jan. 14	10	8	12	4	1	1	2	1	1	4.4
	Mar. 28	16	5	8	4	3	0	3	2	1	4.6
	June 16	8	13	5	4	2	1	6	0	2	4.5

The adding test was too short to be of great value. In future tests a larger number of figures will be employed, and a different method. After the specified amount of adding has been done, it will be at once repeated on another equivalent set of examples. The excess of time required for the second set over that required for the first may be called the "fatigue time," and this fatigue time, taken as a percentage of the total time of adding, may be used as a criterion of endurance—the less it is, the greater the endurance, and *vice versa*. This plan was developed too late to be put into operation at the beginning of the experiment. It was, however, employed in the March and June tests, and confirmed the conclusion reached above, that there was little difference between the mental endurance in March and June. Five of the men showed a less "fatigue time" in June than in March, and four a greater.

The following statements of the men themselves will show that their feelings as to working power were in harmony with the conclusion that it had improved :

Subjective Impressions as to Mental Working Power.

B. (March) "Not decreased at any rate, seems to have increased."
(June) I did more work during the latter part of year than I ever did before in an equal period of time. But, I had the work to do and compelled myself to do it. However, I was mentally tired at the close of the year, particularly so at the time of the test, for it came after the siege of exams for which I did my own work besides a couple of days of hard tutoring.

This much, at any rate, is positive : There was no decrease of mental power resulting from the experiment. I was no more tired at the close of last year than I was at the close of the year before. After a week's rest I felt quite normal and then did considerable mental work all summer.

E. (March) "Working power improved. Can concentrate attention for a longer time."

(June) "I accomplished a greater amount of mental work than in previous years during the corresponding period of the college year. I do not think that my feeling of fitness for it was any greater, however, and I cannot say that my experience of fatigue after the work was any less. I learned to eat slower than had been my custom during previous years. Though not subject to indigestion, I experienced less stomach disorders during the period of the experiment."

Lq. (March) "I have put in more long hours during this term than any previous term, consequently have had a good deal less sleep. I do not know that I can work any better, except that I can work a longer period at one time without feeling so tired from it."

(June) "Of course a great deal of the extra work was outside work which was an extra tax. I, however, did a great deal more work on papers that I prepared than I ever had before. . . . Although I spent longer hours than before I did not feel the effect of the work so much as before."

Lw. (March) "Have been working harder during the past four months and have taken less exercise than at any other equal period during past 2½ years. The character of the work has been so different that I am unable to say whether there is any increase in working power, but I find that I rest up very quickly after becoming tired (mentally).

"When March tests were taken I did not feel as 'fit' for test on that particular day as at time of January tests. Had been working hard and had been under nervous strain, which undoubtedly affected the tests."

(June) "I have worked harder from January to June than ever before, and have taken less exercise. As my mental work was so different from that previous, I cannot form an estimate of any increase or decrease in efficiency, but as I have said before, I always rested up more quickly."

M. (March) "I think on the whole a slight improvement."

(June) "Do not notice any change."

P. (March) "I have never worked so steadily, or with so little necessity to exercise the will to work, as in the central six weeks of the test. The work I was doing was chiefly research in the Library, poring for three or four hours at a time over old records—not labor of the most interesting kind."

(June) My work from March to June was of a more confining sort than ever before in the spring. From March to the Easter recess I was occupied with library research; from Easter on I was engaged on an essay and the marking of some 260 Social Conditions theses. On these last I spent considerably more time and effort than in the preceding year. Thus my work was harder and more time-filling than usual. I had much less out-door exercise than in previous springs, and missed that relaxation from effort which all prior springtimes have bred. Yet there was no feeling of overwork, or even of work as a burden, till the first of June. From then on I did feel tired, and examination time found me with a mind very difficult to keep in harness. Undoubtedly I had over-pushed myself, but did not realize it till June. . .

R. (March) Felt an increase in efficiency.

(June) My power for mental work was greater between the March and June tests than between the January and March tests and the latter was greater than before the experiment began in January. I can state without hesitation that my mental working power increased in consequence of "Fletcherizing."

T. (March) Felt that he had at least held his own, but "surprised to find that every one of my tests (physical) had improved." For the first test came after the rest and recreation of the winter holidays when he "was in splendid condition. Since then I have had to work extremely hard with little regular exercise and rarely in bed before about midnight." Surprised also that the mental test showed no improvement, probably because "the confusion around me was considerably greater than in the first test." Can do his ordinary mental work faster than before, though not sure that he can work longer.

(June) "I consider I did more work last year during the period of the experiment than any other year. During the whole nine months of the college year I was practically working up to my limit of endurance. I did not grow sleepy as early evenings as previous years and my attention was not as easily distracted from my work as previous years.

"The lack of improvement in the second mental test may have been due largely to the fact that I was mentally fagged out after the examinations and was feeling the need of my holidays."

W. (March) No definite impression either of gain or loss.
(June) "On the whole I felt quite as workish as ever I did in the spring months and did not feel the hot days as much of a drag as usual."

As to illness, in the course of the experiment there were the usual winter colds, though apparently these were less common than before. One man had grip for a few days, another the mumps, and several had constipation. In general, the men expressed themselves as better than usual and in some cases they were very enthusiastic. None of the ailments suffered by the men were ascribable to the test itself, unless it be a case of what appeared to be slight rheumatic sensations of T., who had always been a heavy meat-eater, and who during the experiment introduced at first much acid fruit. That the acid in conjunction with the high proteid might occasion such symptoms is at least consistent with some of the numerous theories of rheumatism. On avoiding very acid fruits he soon lost all these symptoms.

The following extract from the diary of B. is, I think, typical of the facts in this respect to general health: "Have now, March 23, slight sore throat. In regard to colds, I have been troubled less this year than at any time for years; but this fact may be due to great change in climate, Nebraska to Connecticut. Have usually had colds more or less all winter; therefore my freedom has been indeed remarkable. From September last till the beginning of the experiment I experienced frequent attacks of indigestion, 'heart-burn.' Have been almost free from that, though two or three times I had the same experience after eating bananas."

Summary.

The phenomena observed during the experiment may be summarized as a slight reduction of total food consumed, a large reduction of the proteid element, especially for flesh foods, a lessened excretion of nitrogen, a reduction in the odor, putrefaction, fermentation and quantity of the feces, a slight loss of weight, a slight loss of strength, an enormous increase of physical endurance, a slight increase in mental quickness. These phenomena varied somewhat with different individuals, the variations corresponding in general to the varying degree in which the men adhered to the rules of the experiment.

That we are correct in ascribing the results, especially in endurance, to dietetic causes alone, cannot reasonably be doubted when it is considered that no other factors of known significance were allowed

to aid in this result. On the contrary, so far as the operation of other factors was concerned, these must have worked against rather than for the results achieved. Exercise was in no case indulged in to a greater extent than had previously been the custom, and in most cases it was less. The men were warned not to take up exercise, except so far as they had been accustomed to before the experiment began, and if they varied their exercise at all, to lessen rather than increase it. They were very conscientious on this point, as on others, —so much so that some of them at first gave up exercising until they began to feel "logy." This over-zeal was corrected ; but in no case have I reason to think that the exercise taken was more, or more systematic, than previously. M. was probably the most systematic in taking exercise. His statement on this point, as previously given, the reader may care to review.

The men did not practice on the endurance tests between times. This was expressly forbidden, and the men were too trustworthy to admit of a doubt on this point. The tests themselves, needless to say, were too far apart to have given any chance for repetition to give "knack," and were too severe to count as beneficial exercise.

Nor were the men more regular in their hours of retiring or other habits. On the contrary, they were rather more reckless in burning the midnight oil. It developed that, with their increased freedom from fatigue, they indulged more freely than ever their propensity to work in the lines of their respective ambitions. At first they felt justified in doing this, as it accorded with their instructions not to remove any handicaps to their chance of improving their endurance, but to increase rather than decrease such handicaps. But this liberty became license, and I was forced to remonstrate with the men for their late hours and overstudy, which tended to rob them of their surplus endurance almost as fast as it accrued. Long before the experiment was finished the men had given every appearance of improved working power, but I was not at all sure that they would have any of it left to show in the final test, because of their tendency to use it up in work. Had the extent of their working proclivities been realized in advance, it is doubtful if the experiment would have been undertaken at all. It should be stated that all except M. were graduate students, and almost all of them, in addition to their university work, were earning their own way.

The advance of warm weather must have tended, had not their diet counteracted it, to tire the men, if, at least, we may trust common impressions as to "spring lassitude."

Again, the conditions immediately preceding the March and June tests, as compared with those preceding the January test, were such as to give the advantage to the January test. The latter came soon after the Christmas holidays, when the men, as they themselves stated, felt refreshed and at their best, whereas the March test came just before the Easter recess, after a hard term's work, and the June tests came after a like period of hard work,—in some cases, as of B. and R., immediately after exhausting examinations.

Finally, the tests themselves were serious drains on vitality. Each required a period of from several days to two weeks for recuperation, and each robbed the men temporarily of several pounds of weight. The cookless diet experiment for six days also cost something to those who took part in it.

In addition to the tests mentioned in this report was one on January 23 of leg-raising, deep knee-bending and arm-stretching, taken after a night from which two hours of sleep were purposely cut off. After consideration, it was decided not to repeat this test as being too fatiguing. It therefore has been omitted from this report; but it added one more burden for the men.

When, therefore, we observe the known handicaps,—the over-study, the strain of the tests, the advance of warm weather, the fact that the first test came after rest and the other tests after work, and when we are unable to find any other cause than diet—such as exercise, regularity of bed-time or other habits—we are forced to conclude that the only causes which produced the endurance were dietetic.

Possibly some persons may be disposed to find a convenient escape from this conclusion by ascribing the improvement to suggestion. Under this theory, the men improved because they expected to. It is quite true that there may be more force in autosuggestion than most of us realize. But, fortunately, for the present case we scarcely need to argue the point; for as a matter of fact it was not true that all of the men expected to improve. This was certainly not true before the March test. In fact, the men were about equally divided in their predictions as to the outcome, and used to have animated discussions. Yet, both the confident and the skeptic faction improved in endurance in the March test; and so far as I am acquainted with their prognostications and have noted their improvement, there was little if any correlation between those prognostications and their improvement.

It is of course still *possible* that some unobserved element has crept

into the case, to which, and not to the diet, the improvement in endurance was due; but in view of all the facts recited, this is extremely *improbable.* What slight doubt remains should be resolved by further studies. I earnestly hope that other and more careful studies may be made by more competent investigators than I.

We conclude that the improvement in endurance was exclusively due to dietetic causes. The only dietetic causes at work were (1) thorough mastication, (2) implicit obedience to appetite, (3) (during the second half of the experiment) when appetite did not clearly determine the choice, the voluntary selection of the non-flesh and low-proteid foods, and (4) an ample variety of good foods, well cooked.

So far as cooking is concerned, this cause, as has been said, entered unintentionally. But there is no evidence that it was a prime factor in the experiment, while there is some evidence to the contrary. Thus, E., who especially remarked the culinary virtues of the cook and who missed her services more than any one else during the brief period of her absence, was the one member of the club who failed to improve in endurance.

If we allow ourselves to speculate as to the changes in the character of diet which were produced by thorough mastication, we may draw an inference from the fact that the carnivorous animals are fast-eaters, whereas the grain-eating animals are slow-eaters. It would seem, therefore, when man changes his habits from fast eating to slow eating he naturally changes his food from the food of a fast-eating to that of a slow-eating animal. The question, therefore, which is the natural food for man, may possibly be associated with the question, which of the two methods of eating is natural to man. Was the slow eating of the nine men an artificial and unnatural practice, as would be indicated from the fact that the majority of men eat far faster? Or, are the ordinary habits of man in respect to the manner of fast eating themselves unnatural? I have not attempted to gather the facts necessary to solve this problem, but it certainly constitutes an interesting one for the physiologist and anthropologist. The few facts upon which I have chanced to fall would seem to indicate that man is naturally a slow eater, and that the hurry-habit to which most of us are prone is a consequence of the artificial high-pressure to which modern civilization has subjected us. Certain it is that the conditions which give rise to quick-lunch counters and to the short stops of trains for refreshments, were produced, not in order to meet any natural propensity to eat fast, but on the contrary, in the

interest of the more rapid transaction of business, with which meal-times are regarded as an interference.

We may therefore at least conclude that whatever the speed of eating which is natural to the human animal, his actual speed under civilized conditions is greater than natural. It is noteworthy also that children are very deliberate in eating their cookies. It is only after they are reproved for keeping their elders waiting that they begin to imitate the latter and bolt their food. Dr. Higgins [1] and Dr. Hasse [2] have pointed out also some physiological considerations, based on the anatomy of the human throat compared with the throats of the carnivores and of "poltophagic" animals, which would indicate that man, to a large extent at least, is naturally a slow-eating animal. Dr. Henry Campbell [3] has also given some evidence, based on a study of the primitive tribes, to show that chewing is more thorough among uncivilized races, and that the hurry habit to which we are accustomed is largely promoted by the use of prepared and 'mushy" foods,—which, in fact, appear to have been devised expressly for the purpose of being quickly swallowed.

The evidence, however, on the natural food-habits of man is as yet very meager, and it is only provisionally that we may consider the thorough mastication advocated by Mr. Fletcher as "natural." With this reservation we may say that the experiment here described may be called an experiment in natural eating, or an effort to restore a blunted or lost food-instinct, so that it may serve as a safe guide to the proper quantities and kinds of foods. If it be asked in what way this natural eating tended to improve endurance, whether it was because of the finer sub-division of food through mastication; the increased "insalivation"; the increased flow of "appetite juice"; the better adaptation of foods to the particular needs of the individual and the moment; the lessened quantity of food; the lessened proteid; or the lessened amount of flesh foods, no satisfactory answer can be given, although, as the previous discussion shows, there is more or less evidence on some of these points. There are certainly some very fascinating problems for the physiologist to solve in regard to fatigue as related to diet. Are the "fatigue poisons" due, for instance, chiefly to the combustion of proteid in excess of the physiological

[1] See *Humaniculture*, N. Y. Stokes, 1904.

[2] See Archiv für Anatomie (Waldeyer's) 1905, p. 321.

[3] "Observations on Mastication," London *Lancet*, July 11, 18, 25 and Aug. 8, 1903. Reprinted in Horace Fletcher's *The A. B.-Z. of Our Own Nutrition*, Stokes, 1903. See pp. 126–135.

needs, as the theory of Chittenden would explain them? Or, are they largely due to the ingestion of these poisons with flesh foods, as the vegetarians and Dr. Haig have maintained? Or, do both explanations have a share?

The results of the experiment demonstrated so great an increase of endurance as to seem at first incredible. It certainly was a surprise, both to the men and to me. But statistics which I have been collecting during the last two years have prepared me to find great differences and changes in endurance. The special result of the present experiment is to show that diet is an important factor in producing such alterations. The fact that endurance, even among persons free from disease, is one of the most variable of human faculties—far more variable than strength, for instance—is evident to any one who has made even a superficial examination. Some persons are tired by climbing a flight of stairs, whereas the Swiss guides, throughout the summer season, day after day spend the entire time in climbing the Matterhorn and other peaks; some persons are "winded" by running a block for a street car, whereas a Chinese coolie will run for hours on end; in mental work, some persons are unable to apply themselves more than an hour at a time, whereas others, like Humboldt, can work almost continuously through eighteen hours of the day. Among statistics gathered independently of the present experiment, I have found measurable differences between persons far greater than the change of endurance of the eight students which we have seen.[1] Among some 50 tests of different persons holding their arms horizontally, many were found whose arms actually dropped against their will inside of ten minutes, whereas several were able to hold them up over an hour, and one man held them 3 hours and 20 minutes, or a round 200 minutes, and then dropped them voluntarily. Similarly with deep knee-bending, some persons were found physically unable to rise again from the stooping posture after accomplishing less than 500 bendings, whereas several succeeded in stooping 1,000 times, and in one case, 2,400. Again, in leg-raising, the legs positively refused to rise to the vertical in some cases before 40 times were reached, whereas in two cases this motion was performed 1,000 times or over. On the new ergograph previously referred to, among the 16 preliminary tests there was a range in endurance between different persons from 18 to 145 and in the same person at different times from 29 to 110.

[1] For an account of some of these statistics see "The influence of flesh-eating on endurance." *Yale Medical Journal*, March, 1907.

It is, to say the least, remarkable that hitherto so little effort has been directed toward discovering the factors which explain such differences in endurance. That exercise is one of the most and perhaps the most important factor has alone been recognized. A correspondent assures me that by means of moderate *regular* exercise he succeeded in increasing his endurance between 100 and 200% in three weeks as measured by leg-raising and "dipping." The influence of diet has always been regarded as small or negligible, and the opinion has been almost universal, until recently, that a diet rich in proteid promotes endurance. Even among those whose researches have led them to the opposite conclusion, there is very little conception of the extent to which diet is correlated with endurance. Such a person, a medical friend of the writer, stated, when the present experiment was planned, that he did not think the dietetic factor strong enough compared with others to produce any marked effect. We have all heard, of course, of the enthusiastic reports of vegetarians as to their increased endurance, but these we have discounted as exaggerations. The result of the present experiment, however, would seem to indicate that one's improvement in endurance is usually not less, but greater, than he himself is aware of. Probably it is also true that we may lose a large fraction of our working power before we are distinctly conscious of the fact.

While the results of the present experiment lean toward "vegetarianism," they are only incidentally related to that propaganda. Meat was by no means excluded; on the contrary, the subjects were urged to eat it if their appetite distinctly preferred it to other foods.

The sudden and complete exclusion of meat is not always desirable, unless more skill and knowledge in food matters are employed than most persons possess. On the contrary, disaster has repeatedly overtaken many who have made this attempt. Pawlow has shown that meat is one of the most and perhaps the most "peptogenic" of foods. Whether the stimulus it gives to the stomach is natural, or in the nature of an improper goad or whip, certain it is that stomachs which are accustomed to this daily whip have failed, for a time at least, to act when it was withdrawn.

Nor is it necessary that meat should be permanently abjured, even when it ceases to become a daily necessity. The safer course, at least, is to indulge the craving whenever one is "meat hungry," even if, as in many cases, this be not oftener than once in several months. The rule of selection employed in the experiment was merely to *give the benefit of the doubt* to the non-flesh food; but even a *slight* preference for flesh foods was to be followed.

Under flesh foods are included all meat- and "stock-" soups. It has been shown that although these extracts of meat contain a large amount of nitrogen, it is not in the form of proteid which can be utilized, but only of waste nitrogen which must be excreted. Apparently the sole virtue of such soups is that they supply the "peptogene" stimulus above referred to.

The experiment will be seen to harmonize with and supplement the experiment of Professor Chittenden, on which it was founded; but the objects of the two experiments were quite different. Professor Chittenden's was aimed to ascertain the physiological requirements as to proteid, and did not touch upon the question of endurance. Moreover, Professor Chittenden, in order the better to measure the proteid and nitrogen, artificially reduced the quantities ingested, whereas in the present experiment, test was made of Mr. Fletcher's claim, that thorough mastication leads naturally to the adoption of the physiological amount of proteid. This we found to be true, especially after the introduction, at the middle of the test, of the suggestion that when appetite was in doubt, the lower proteid foods should be selected. But the tendency was quite marked during the first period also, and might have been expected to lead to the same results without the introduction of even the suggestion of voluntary choice, had the experiment been long enough. This was the experience of others, notably Mr. Fletcher himself, whose case, in fact, first called Professor Chittenden's attention to the possible virtues of low proteid.

The practical value of the experiment consists in the fact that any layman can apply it, with or without a knowledge of food values, though with more advantage if he possesses than if he lacks such knowledge.

If the dietetic rules of the present experiment are followed, no self-denial as to foods is required. It is, however, absolutely necessary that there should be *self-control* enough to break up the habit of hurried eating to which modern civilization has brought us, habituating us, as it does, to eat against time.

Experience indicates that appetite does not lead to a diet fixed in amount or constituents, but moves in undulating waves or cycles. The men who took part in the experiment were encouraged, after any of the symptoms which seemed to be associated with high proteid (such as heaviness, sleepiness, stiffness or soreness after exercise, or catching cold), to cut down on their proteid and substitute fat to restrain the gastric juice. This advice was intended to make

application of the theories of Folin[1] that we usually carry a reservoir of proteid, enough to supply our needs for body-building for a fortnight. If this reservoir is exhausted, proteid starvation occurs and the body feeds on itself ; if it is filled too far it overflows and causes the evils of excessive proteid. If this theory is correct, the art of eating may consist largely in maintaining a golden mean such that the proteid reservoir is neither empty nor overflowing, or at any rate, not overflowing much. Many persons fear to reduce their proteid to the Chittenden minimum for fear of proteid starvation; but the experience of those who have tried it would seem to show that this fear is groundless, *provided* no violence is done to natural appetite. This may be trusted, so it would appear, to raise a warning in the form of "nitrogen hunger" before the danger point is reached.

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[1] "A Theory of Protein Metabolism." *American Journal of Physiology*, March, 1905.

A GRAPHIC METHOD IN PRACTICAL DIETETICS

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NEW HAVEN, CONN.

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A GRAPHIC METHOD IN PRACTICAL DIETETICS

IRVING FISHER, Ph.D.
Professor of Political Economy, Yale University, and Secretary of the New Haven County Antituberculosis Association
NEW HAVEN, CONN.

Professor Mendel, in an address on dietetics before an audience of Boston physicians, asked the very pertinent question: "Why do physicians take so much care in measuring their dosages of drugs, which are administered only occasionally, and so little care in measuring their food prescriptions, which are to be followed daily?" In prescribing drugs, a physician would be regarded as criminally negligent if he simply told his patients to take "a little" strychnia, but to be sure "not to take too much;" or to take a "big dose" of calomel. Yet in prescribing diet, physicians often give just such advice.

Doubtless in the scheme of Nature man was not expected to measure his food. He was provided with healthy, normal instincts instead. But, as often happens in diseased conditions, the food instinct has sometimes become perverted and cannot be trusted. The consumptive requires, or at any rate is believed by most physicians to require, more food than his appetite calls for, and the victim of kidney diseases less. To reestablish the instinctive guides to food selection should doubtless be the ultimate aim of the physician; but, to that end, a quantitative determination of the food actually used, and a quantitative regulation thereof, may be advantageously employed. As yet, however, neither the quantity of food nor the proportions of its constituents have been often prescribed with precision.

What Dr. Burton-Fanning says of prescribing food for the consumptive applies to food prescriptions in general, that the whole art of such prescriptions is

summed up in the word accuracy.[1] Until recently accuracy was impossible. But to-day, by the aid of elaborate tables of food values constructed by Atwater and Bryant in America, and of mineral salts by Koenig in Germany, and, if great accuracy is required, of coëfficients of digestibility, it has become possible to make a true measurement of diet prescriptions.

As to mineral salts, we know at least in which foods they are severally to be found. For instance, if a patient needs iron, he may, instead of taking the preparations of the druggist, have added to his list of foods one or more of the following: lentils, asparagus, lettuce,

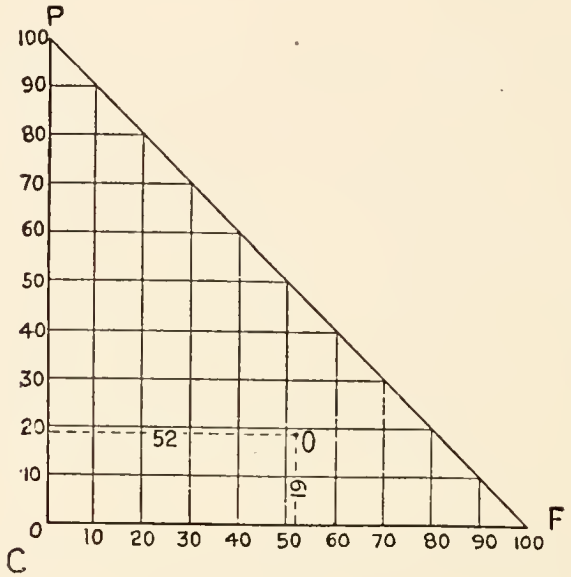

Figure 1

peas, figs, strawberries, spinach, beans, potatoes, prunes or apples, the order of which is that of the amount of iron contained in proportion to total food value.

Again, if calcium is needed, instead of limewater there may be administered milk, figs, cabbage or lentils. If sulphur is needed, the patient may be given potatoes, peas, beans, asparagus or cabbage; if phosphorus, beans, peas, rice, milk; if silicon, lettuce, cabbage, strawberries, rice, potatoes, barley or cucumbers; if magnesium, peas, beans, cocoanuts, barley and rice; if chlorin, cocoanuts, milk, lentils, asparagus, cabbage; if sodium,

1. For a statement of the great divergences of sanatoria from this ideal, see "Statistics of Diet in Consumptive Sanatoria," Fisher, Tran. Second Annual Meeting, Nat. Assoc. for Study and Prevention of Tuberculosis, New York, 1907; also in Am. Jour. of the Med. Sci., October, 1906.

lentils, figs, asparagus; if potassium, beans, lentils, peas, cocoanuts, potatoes. Or if simply mineral salts in general are required, they are found in large quantities in proportion to food value, among lentils, peas, beans, cocoanuts, potatoes, milk, rice, figs, apples, barley, cabbage and chestnuts.

There are data also which describe the amount and kinds of acids in foods, their peptogenic qualities, their effects on peristalsis, etc.

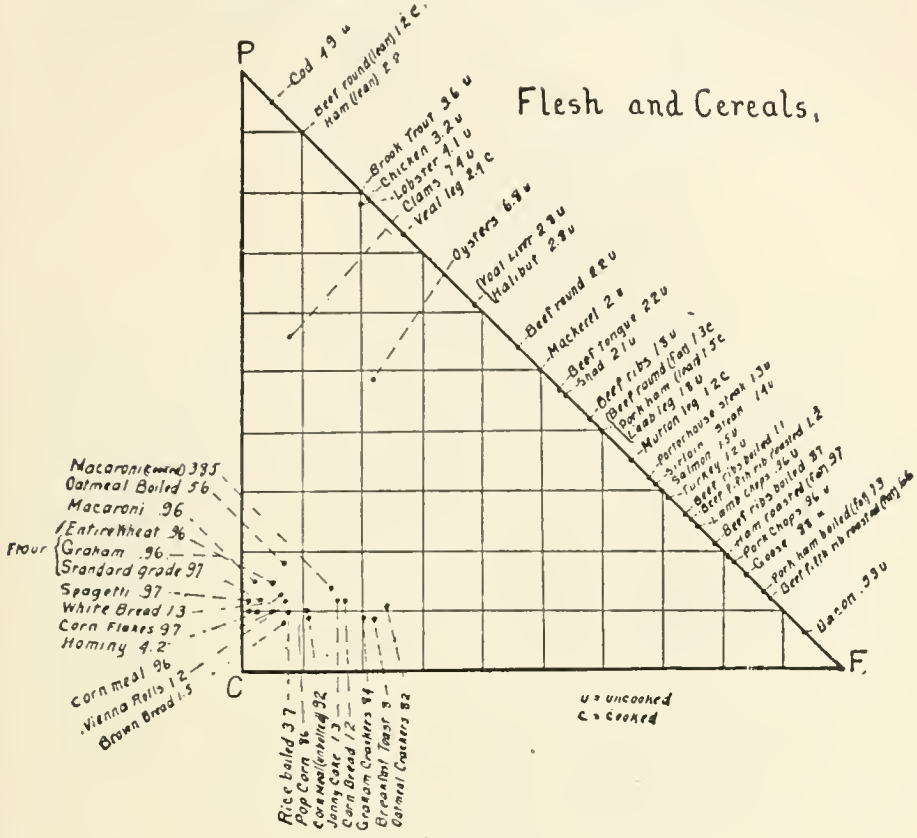

Figure 2

THE BASIS OF COMPUTATION

But the ordinary problems of dietetics are concerned not so much with these minor constituents and properties of foods as with the amount and proportions of proteids, fats and carbohydrates.

Two methods have hitherto been used for computing proportions of proteids, fats and carbohydrates. One consists in using the tables of percentages by weight of proteids, fats and carbohydrates; the other, Dr. J. H. Kellogg's, in using a table which gives the number of calories in the form of proteids, fats and carbohydrates per ounce of each kind of food. These may be described.

respectively, as the method of weight per cent. and the method of calories per ounce. The method here suggested is different from either, and may be called the method of calories per cent. It takes as its starting point not a unit of weight, but a unit of food value, called a "standard portion" of each kind of food. A "standard portion" is defined as that amount of food which contains 100 calories. A table is constructed which gives the weight in a "standard portion" of each particular kind of food, and out of the 100 calories con-

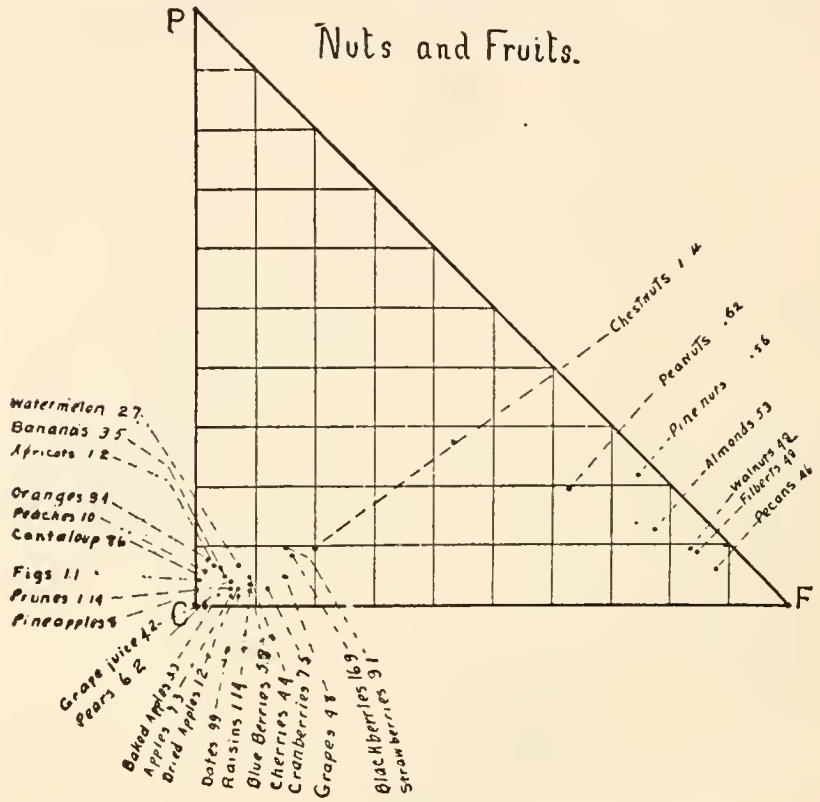

Figure 3

tained therein the number of calories in the form of proteids, fats and carbohydrates. The three methods were discussed and the last-named explained in detail in another paper.[2] We shall, therefore, pass over this part of our subject very briefly in the present paper and devote our main attention to the practical application.

In order to carry out this method, foods should be served at the table in "standard portions" or simple multiples thereof. The amount of milk served, instead

2. Fisher: "A New Method for Indicating Food Values," Amer. Jour. of Physiol., April 1, 1906.

of being a whole number of ounces, should be (for average milk) 4.9 ounces—the amount that contains 100 calories. This "standard portion" constitutes about two-thirds of an ordinary glass of milk. Of the 100 calories which it contains, 19 will be in the form of proteid, 52 in fat, and 29 in carbohydrates. In other words, of the food value of milk, 19 per cent. is proteid, 52 per cent. fat, and 29 per cent. carbohydrates.

One advantage of this method is apparent at once. It enables us to make a true comparison between dif-

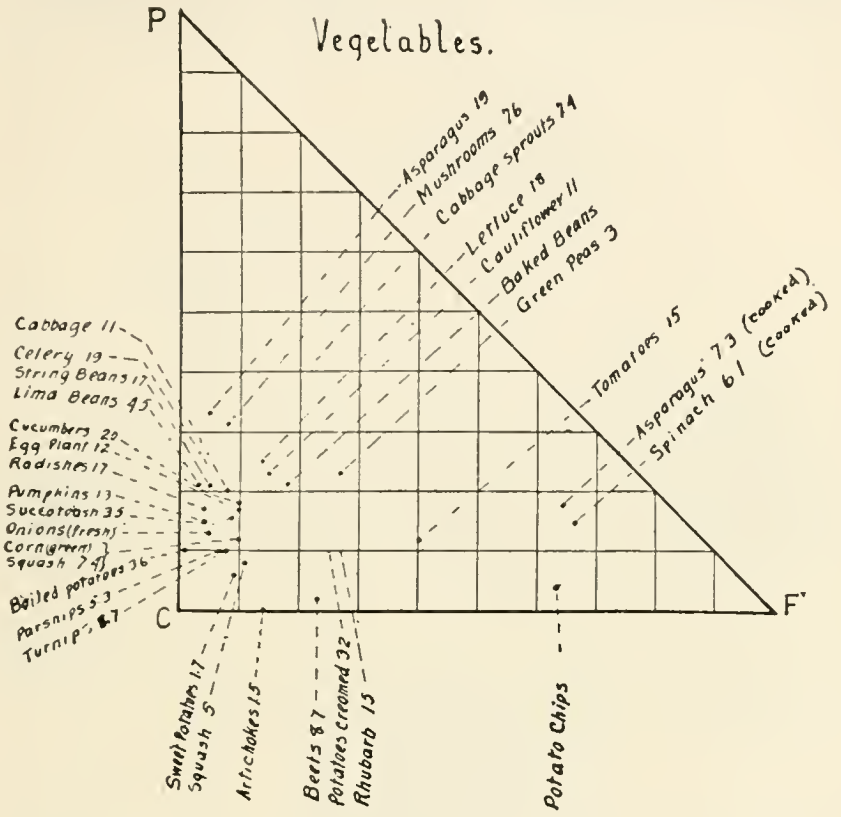

Figure 4

ferent foods as to the relative amounts of proteid, fat and carbohydrate. The other methods are misleading in this regard. For instance, though it is well recognized that milk is a higher proteid food than pecan nuts, yet if we compare milk and the pecans on the basis of the method of "weight per cent.," we shall find that the pecans appear three times as rich in proteid, milk containing 3.3 per cent. and pecans 11 per cent. But if we compare them on the basis of "calories per cent.," we find that, while milk contains 19 calories of proteid out of each 100 of total calories, pecans contain only 6, milk

showing three times as much proteid as pecans. The paradox that pecans are higher in proteid per ounce but lower in proteid per 100 calories is due to the fact that pecans are a much more concentrated food than milk: whereas 100 calories of milk weigh 4.9 ounces, 100 calories of pecans weigh only half an ounce. The weight of a "standard portion" of any food, i. e., of that amount which contains 100 calories, is a measure of the degree of concentration. The most concentrated of all

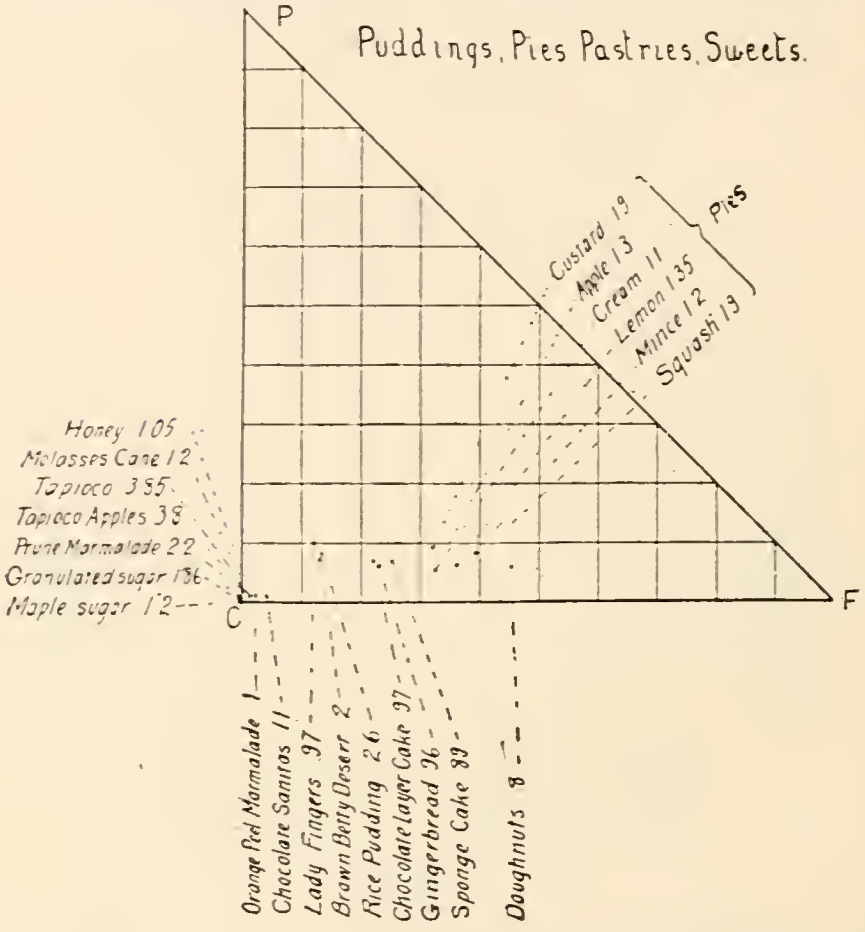

Figure 5

foods is probably olive oil, which contains 100 calories in a little over one-third of an ounce (0.38 oz.). Watermelon represents a food at the opposite extreme, of which over 1½ pounds are required to yield the 100 calories. In order that the "calories per cent." method may be easily put in practice, it is necessary to have a table giving the weight constituting a "standard portion" (i. e., the amount yielding 100 calories) and the calories of proteid, fat and carbohydrate in this portion.

At the close of the present article such a table is given, computed chiefly from the tables of Atwater and Bryant and, for made dishes, from those of Dr. Kellogg. The chief advantage of this method of expressing food values is that it lends itself readily to graphic representation. The difficulty in the practical use of most tables of food values is that they cannot be visualized.

THE GRAPHIC METHOD

Different foods contain the three food elements, proteids, fats and carbohydrates, in different proportions. The tripartite constitution of any particular food is rep-

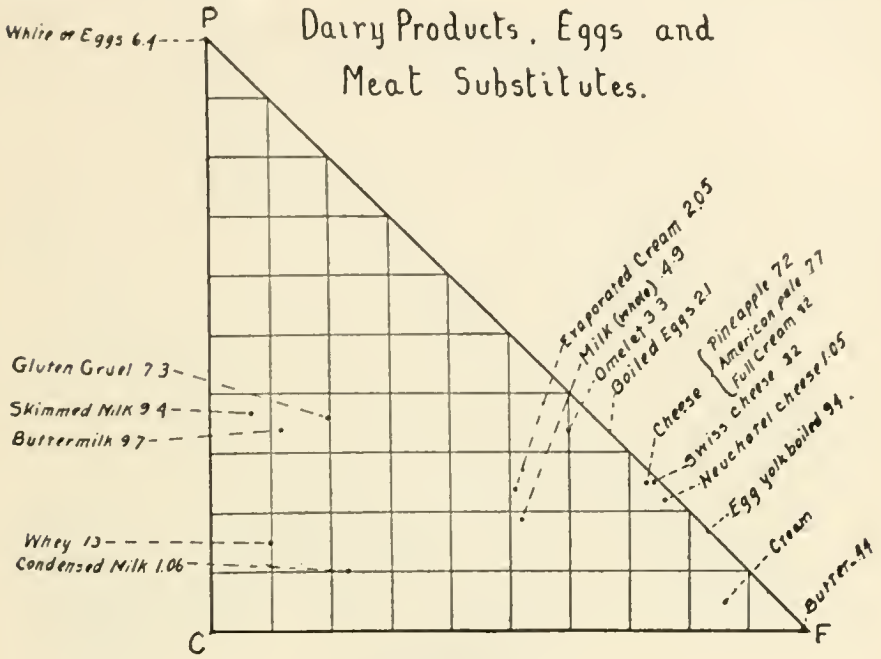

Figure 6

resented in the present method by the position of a point in the triangle[3] CPF (Fig. 1). The method of locating the point on the triangle is analogous to that of locating a city on a map by latitude and longitude: the per cent. of proteid[4] in the food is represented, like latitude, by the height of the point above the base line CF (the total height, CP, being taken as 100 per cent.). The percentage of fat is represented, like longitude, by the distance of the point horizontally from the vertical

3. For convenience, the triangle is drawn with one angle, C, a right angle and the two sides about it equal.

4. I employ the term proteid, although in the tables the figures represent "protein" (i. e., 6¼ times nitrogen), the usual makeshift for proteid.

line CP. (the total horizontal breadth, CF, being taken as 100 per cent.). Thus, the point O, representing milk, is located at a height above CF ("latitude") 19 per cent. of the total height of the triangle, which signifies that 19 per cent. of the food value of milk is proteid; and at a distance to the right of CP ("longitude") 52 per cent. of the total breadth of the triangle, which signifies that 52 per cent. of the food value of

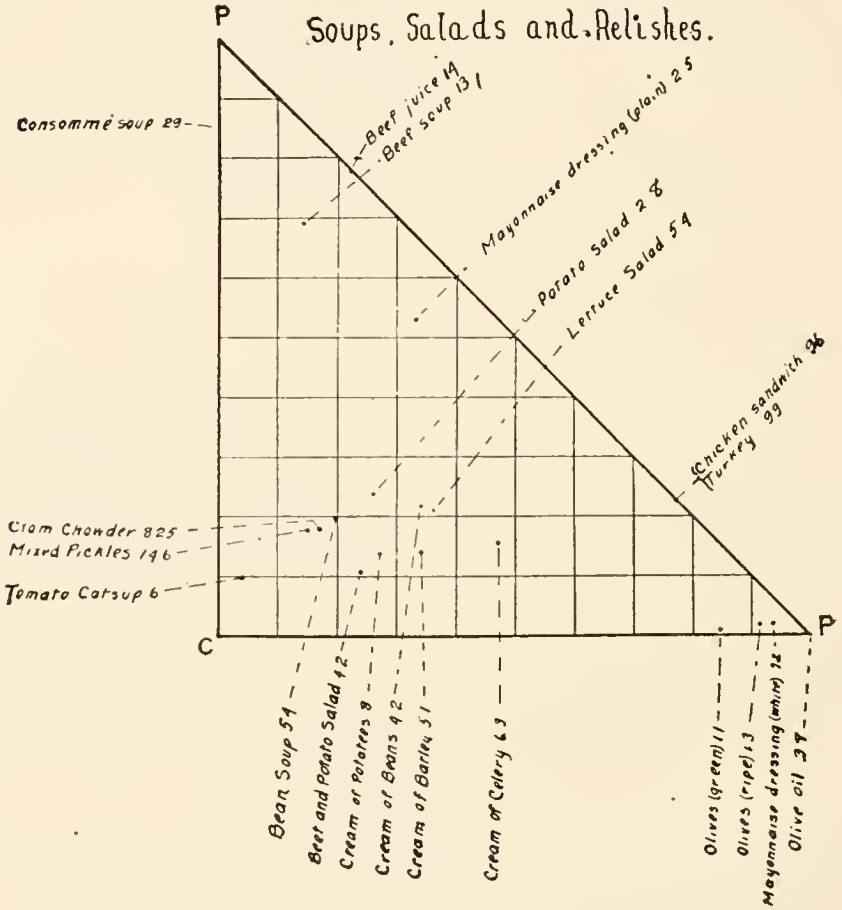

Figure 7

milk is fat. Foods high in proteid will be represented by points high up in the triangle. White of egg, of which the food value is all proteid, will be represented at the point P, representing 100 per cent. P is, therefore, called the "proteid corner" of the triangle. Foods rich in fats, as nuts, cream, butter, are represented by points far to the right. Pure fats, like olive oil, are located at F at the extreme right, representing 100 per cent. of fat. F is, therefore, called the "fat corner."

The point representing a food is completely located by means of the percentage of proteid and fat; no attention need be paid to the carbohydrate. If, however, it is desired to find the carbohydrate, its percentage is readily determined, being what is left of 100 calories not already accounted for by proteid and fat. Thus, a "standard portion" of cottage cheese, being 76 per cent. proteid and 8 per cent. fat, will have left 16 per cent. of carbohydrate. If one desires a graphic representation, it is found in the distance of the point O from the third side of the triangle, FP (the total distance of this side

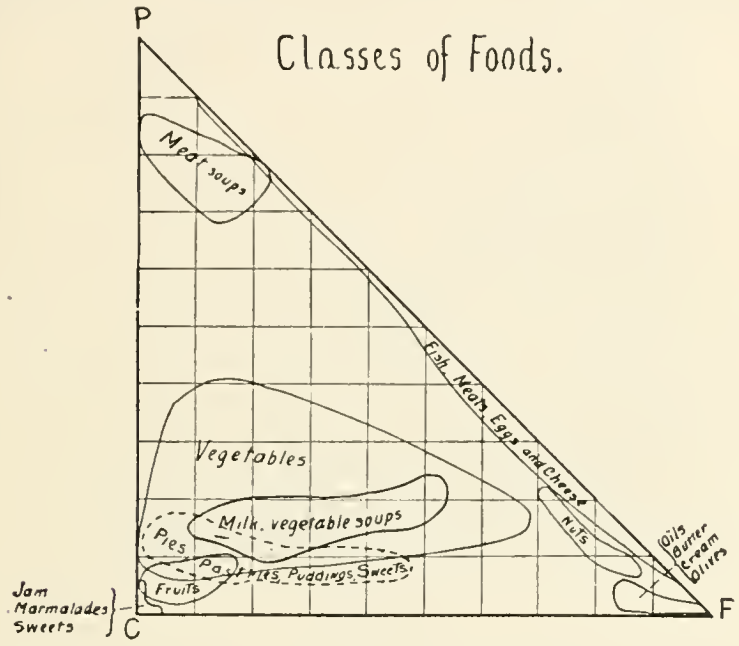

Figure 8

from the opposite corner being taken as 100 per cent.). Foods like bread, cereals and fruits, which are mostly carbohydrate, will thus be represented by points far away from the side FP. Foods such as sugar, of which the food value is wholly carbohydrate, will be represented at the remotest point C, representing 100 per cent. carbohydrate, which is, therefore, called the "carbohydrate corner."

Any food is thus represented on the "food map" by a point the relative distances of which from the three sides of the triangle represent the proteid, fat and car-

bohydrate.[5] On this food may, fatty foods are represented by points near the fat corner, F, starchy and saccharine foods by points near the carbohydrate corner, C, and proteid foods by points near the proteid corner, P. A food devoid of proteid is evidently located on the base line C; a food devoid of fat, on the side CP, and a food devoid of carbohydrate on FP. The chief classes are represented in the accompanying diagrams, flesh foods and cereals being shown in Figure 2, nuts and fruits in Figure 3, vegetables in Figure 4, puddings, pies, pastries and sweets in Figure 5, dairy products, eggs and meat substitutes in Figure 6, and soups,

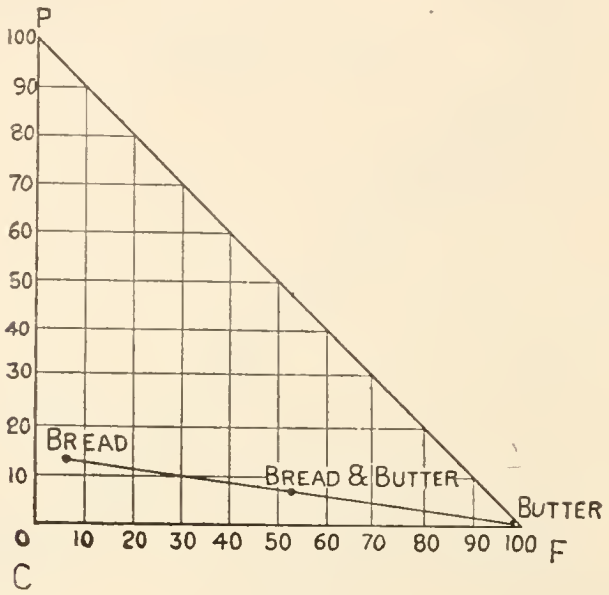

Figure 9

salads and relishes in Figure 7. In each case the position of the point relatively to the sides of the triangle represents the proportions of the proteids, fats and car-

5. It has been shown elsewhere (Amer. Jour. of Physiol., April, 1906, pp. 422-4) that this method of visualizing the composition of any food carries another method with it. If from the point O (Fig. 1), the position of which in the triangle indicates the food composition (of milk for instance), we draw straight lines to the three corners of the triangle, thus resolving the triangle into three constituent triangles, it may be shown that if we call the total area of the triangle 100 to represent a "standard portion" (100 calories) of the food, then the three partial triangles will exactly represent the constituents for proteid, fat and carbohydrate. The triangle representing proteid is COF, i. e., the triangle whose altitude to O represents proteid in the first method. Similarly, COP represents fat, and POF carbohydrate. For the graphic representation of particular foods by this method of triangles, see the article already cited. In the present article only the method of lines or, as we may call it, the "latitude and longitude" method will be employed.

bohydrates, and the number opposite each name represents the weight (in ounces) of a "standard portion."

This method of representing food values reveals some striking facts—for instance, the great variations in the proportion of proteid in different vegetables. Vegetables are commonly supposed to be low in proteid. This is true of some vegetables, such as beets, artichokes and sweet potatoes; but others are high in proteid, such as asparagus, cabbage, cauliflower, celery, cucumbers, eggplant, radishes, spinach, squash and tomatoes.[6] Among fruits also we find some instances of moderately high proteid, such as strawberries and blackberries, oranges

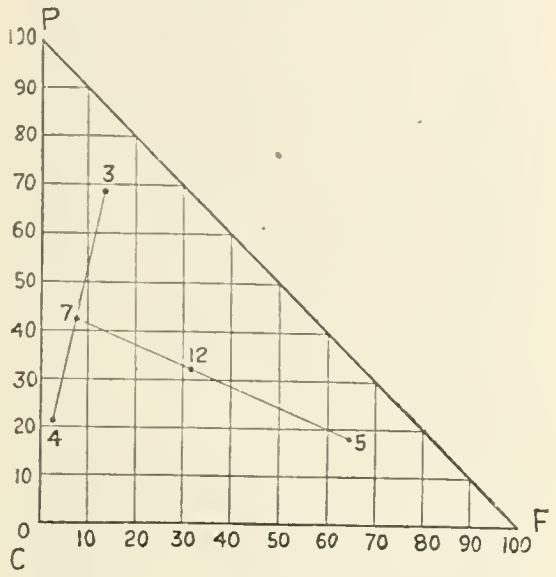

Figure 10

and watermelon. These foods are as high in proteid, in proportion to total food value, as most nuts and cereals. On the other hand, dried fruits, which are sometimes mentioned as containing a higher percentage of proteid than other fruits, are as a matter of fact often much lower. Thus, dates contain but 2 per cent., prunes and raisins 3 per cent., figs 5 per cent.

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6. It should be stated, however, that all estimates of proteid are, strictly speaking, "protein," i. e., 6¼ times the contained nitrogen. In some cases proteid and protein are not identical, but the former is less than the latter, owing to the fact that some of the nitrogen is not in proteid, but in a waste or useless form. This is true of almost all the proteid of meat soups, which have, therefore, practically no food value except a peptogenic one. As to vegetables, in default of exact data, no correction from protein to proteid is here attempted.

It is evident that in most cases foods of the same class show a family resemblance. Meats and other flesh foods, with the exception of shellfish, are represented by points on FP, being devoid of carbohydrates. Cereals are represented by points near the carbohydrate corner, C; nuts, with the exception of chestnuts, are located near the fat corner, F; fruits, with the exception of olives, near the carbohydrate corner, C; vegetables show a large range within the triangle. In Figure 8 the range of each of these classes is approximately shown.

The foods eaten at a meal may thus be indicated by points on the "food map." Opposite each point should be written the amount eaten, measured in "standard

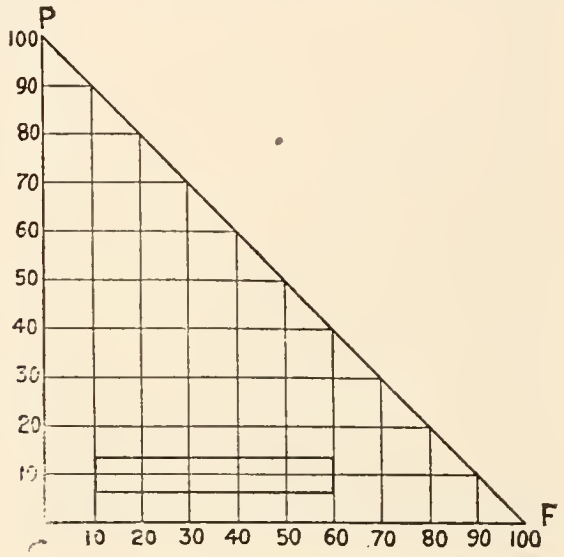

Figure 11

portions." This array of points presents a picture of what foods and how much of each have been eaten, and shows at a glance their characteristics. But to use this properly we need to combine these points into one point, their center of gravity, which represents the entire meal. This may be done in various ways.

DEMONSTRATING COMBINATIONS

The combination of two foods equal in calories is represented by a point midway between them. Thus, to combine one "portion" of bread and one "portion" of butter (Fig. 9) draw a straight line between their points, and at the middle of it mark a cross and label it "2;" this point will represent two "portions" of bread and butter.

If the calories of the two foods are unequal, the point representing the combination will be proportionately nearer the point with the larger number. Thus, if one portion of bread is combined with one-half portion of butter, the bread-and-butter point will not be midway between the points for bread and for butter, but will lie twice as near the bread point as the butter point. Its approximate position may be found with great rapidity by the eye without making exact measurements.

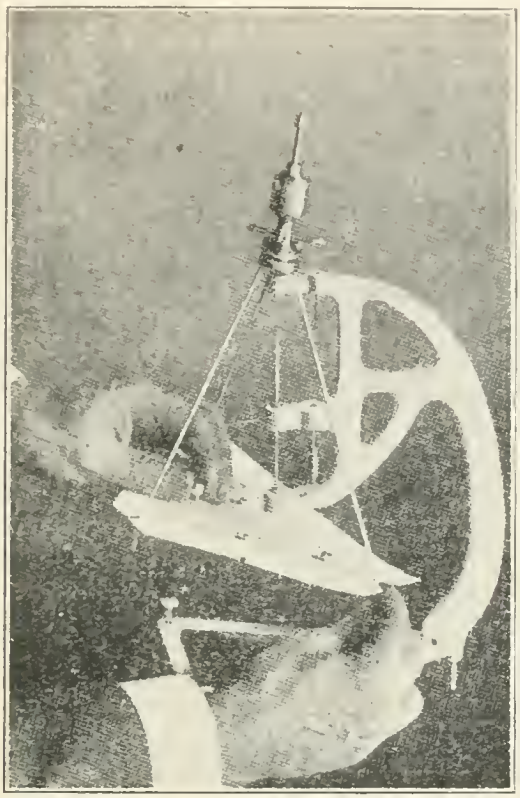

Figure 12

When three foods are combined, the point representing the combination is, in like manner, the "center of gravity" of the three, and may be found by first obtaining the center of gravity of two, and then obtaining the center of gravity of the point thus obtained, and the third. Thus if, as in Figure 10, we have three points representing, respectively, 3, 4 and 5 calories of three separate foods, shown by the attached numbers 3, 4 and 5, the point representing the combination may be found by joining the points labeled 3 and 4, and finding their center of gravity, 7, situated nearer the point 4 than

point 3, and dividing the line between them in the ratio of 3 to 4. The first two points, 3 and 4, may be considered as concentrated at 7 with their combined weight, 7. We then find the center of gravity of this new point 7 and the remaining point, 5. The center of gravity of this point 7 and point 5 will be a point, 12, on the straight line between them, situated nearer the 7 than the 5, and dividing the distance between in the ratio of 5 to 7. At point 12 the whole combination of 12 portions may be considered to be concentrated. It is evident that we could find the center of gravity of the same three points by combining them in a different order, but the result would be the same.

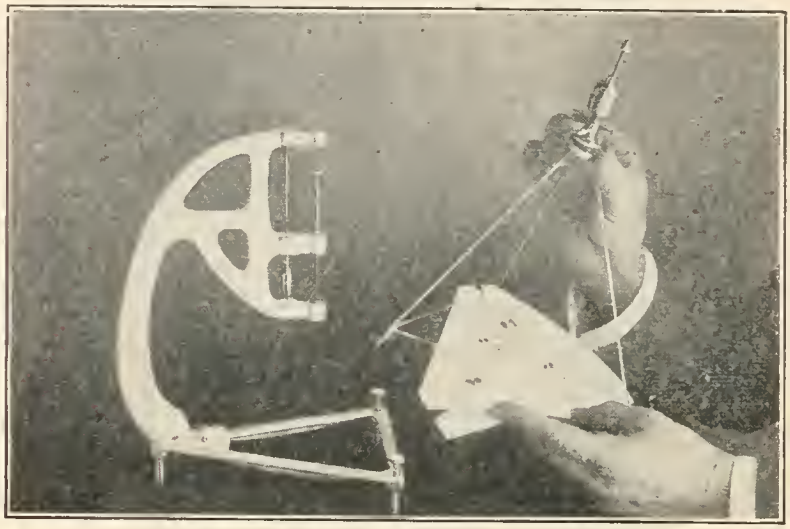

Figure 13

It is also evident that more than three points may be combined on the same principles by combining them by twos and threes and then combining the combinations.

When all the points are combined into one point, that point will represent the entire meal. If the final point thus found is labeled "22," and is located 20 per cent. up and 30 per cent. to the right, this shows that in all twenty-two "portions" (2,200 calories) have been consumed, of which 20 per cent. (440 calories) are proteid, 30 per cent. (660 calories) are fat, and the balance, 50 per cent. (1,100 calories), are carbohydrate.

The ration here exemplified contains too much proteid. If we accept Professor Chittenden's[7] results as to

7. See his "Physiological Economy in Nutrition," New York (Stokes), 1904.

proteid requirements, a well-balanced daily ration for the average person will be represented by a point lying within the "normal rectangle," as shown in Figure 11. This shows that proteid should be near 10 per cent.

All foods may be classified according to their location relatively to this rectangle. Thus, all foods located above the rectangle are high-proteid foods; all below, low-proteid foods; all within, normal-proteid foods. Looking at the "food map" we see among the high-proteid foods, beginning with the lowest, graham bread,

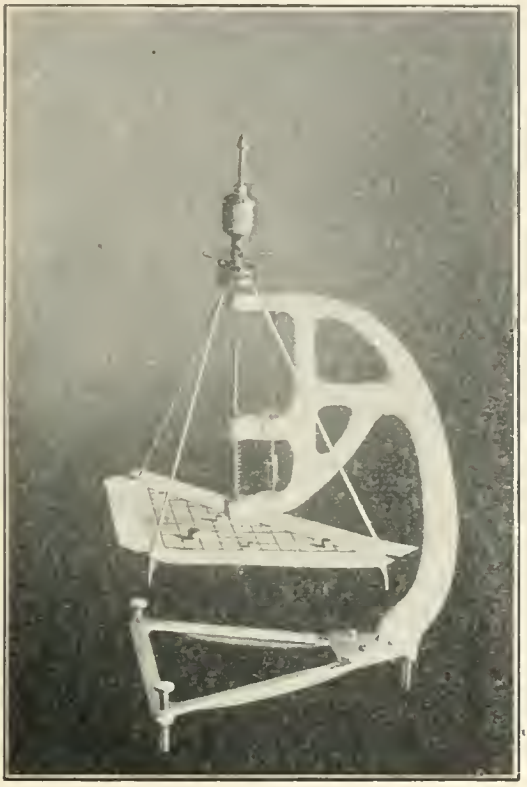

Figure 14

macaroni, tomatoes, whole-wheat bread, pine nuts, beans, buttermilk, cheese and meats. Among the low-proteid foods, beginning with the highest, are most fruits (except raspberries and strawberries), cream, pecans, olives, butter, olive oil, sugar. Among the foods normal in proteid are most breads, wheat flakes, corn flakes, strawberries, raspberries, chestnuts and most other nuts (except pine nuts and pecans). In the same way we may classify foods as to their richness in fat or carbohydrate; but there is a larger range allowable for

these elements than for proteid. High-proteid foods tend to make the ration high in proteid, and will do so unless balanced by low-proteid foods. Most persons consume much more proteid than that in the Chittenden standard. This excess may be avoided either by omitting foods high in proteid or by using them very sparingly.

Since the resultant point, representing the ration, is the center of gravity of the points representing its constituents, it is evident that it can be obtained by

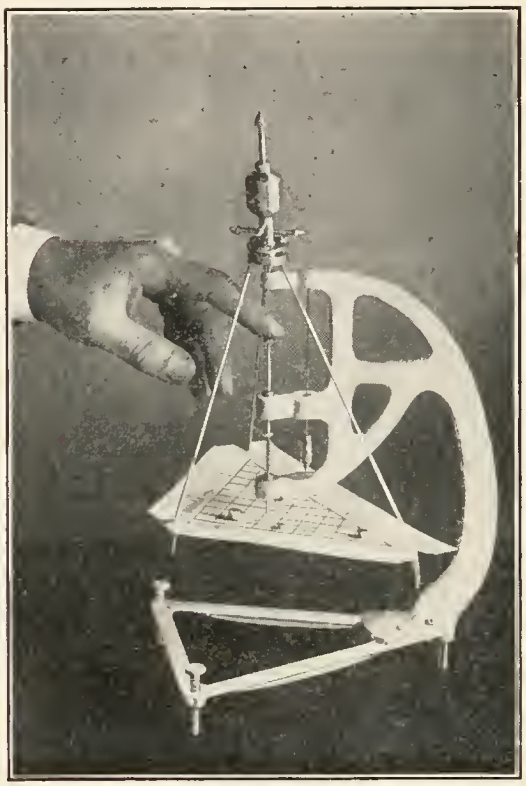

Figure 15

mechanical as well as by geometrical methods. For this purpose a mechanical diet indicator has been devised, as shown in Figures 12, 13, 14, 15.

The essential feature of this apparatus is a card on which is drawn the right-angled triangle with which we have already become familiar. Points on this card may be located to represent the various foods employed. These points may be easily found from tables given at the end of this article. Points representing the most common foods may be already printed on it. At points representing foods eaten, pins with heavy heads are

thrust through the cardboard (Fig. 12), the weight of each representing one "standard portion." Similar pins, but one-half and one-quarter as heavy, are also provided to represent half and quarter "portions." When these pins are placed, the total ration which has been consumed is easily found, simply by counting the "portions" thus represented. For instance, if there are 15 pins representing "standard portions" and 10 pins representing half "portions" (and, therefore, five full "portions"), the total ration is 20 "portions," or 2,000 calories. In order to find the percentages of proteid, fat and carbohydrate in this ration, it is only necessary to obtain the center of gravity of all the pins. For this purpose the card is placed in a basket (Fig. 13) and suspended on a standard (Fig. 14) so that the center of gravity of the pins may assume a position vertically under the point of support. The position of this center of gravity is easily indicated on the card by means of a vertical pricker (Fig. 15), which may be pressed on the card. Thus, almost instantaneously, the center of gravity is found. The total time consumed in placing the pins, adjusting the card and basket, and finding the center of gravity, is found to be, for accurate work, about five minutes.[8]

The mechanism in which the cardboard triangle is held is so arranged that when the cardboard is horizontal the center of gravity falls at a point indicating normal food proportions. If the center of gravity is at some other point, the cardboard will tip, showing that the ration is not "balanced." If the proteid vertex tips down, it indicates an excess of proteid; if the fat vertex, excess of fat; if the carbohydrate vertex, excess of carbohydrate.

It is now evident that, by means of the mechanism and the rectangles marked on the card, it is a simple matter to discover whether a particular diet conforms to any given standard. It is equally simple to correct discrepancies thus found, and, if need be, the corrections may be made in advance and the balanced ration pre-

8. The weight of the cardboard and the basket containing it is eliminated by the construction of the basket. Its center of gravity (when containing the cardboard *without* pins) exactly coincides with the point of support. Hence, when the basket with the card (but *without* pins) is placed on the point of support, it tends neither to swing (which would imply stable equilibrium), nor to be top-heavy (which would imply unstable equilibrium), but is in "neutral" equilibrium, and will remain at any angle at which it is placed.

scribed. A trial ration may be put on the card, and if it fails to balance, the pins may be rearranged and balanced with far greater rapidity than the corresponding operations could be carried out by arithmetical computations.

One advantage, however, of the foregoing methods is that, whether the object is merely to record what is consumed or actually to prescribe, the patient need not be annoyed by having scales at table. All weighing may be done in the kitchen and the food served in "standard portions" or in known multiples or fractions of such portions. It is only necessary that the patient, or some one else, shall report exactly what part of the various portions served has been consumed. The patient need not even know the food values of the portions served to him, and thus the introspection and trepidation, which often defeat the very aim of diet prescription for the sick, may be avoided. For well persons who desire to keep a record of their dietary, the method here given has the advantage that when it is once made familiar it can be employed without any apparatus. One soon becomes able to recognize the quantities of the ordinary foods which contain 100 calories, and to hold in memory the position on the triangle where these foods are indicated. A little reflection will then enable him to judge how many "standard portions" he has consumed at a meal, and also whether their center of gravity falls within the normal rectangle. If he has a good locative imagination, he can rely entirely on his mental image of the triangle. Any one who has once pictured the foods on the "food map" is not likely to forget their several locations. He will know that a meal in which soup, fish, meat, certain high-proteid vegetables, eggs, cheese, milk and ice cream predominate, must be too high in proteid; for all these foods are located above the "normal rectangle." Moreover, he will be able, after a little practice, to estimate roughly the calorific value of his food. A "portion" of 100 calories may be ascribed to each lamb chop, or its equivalent in other meat, each (large) egg, each two-thirds of a glass of milk, each ordinary potato, large slice of bread, large banana, ordinary pat or square of butter, shredded wheat biscuit or its equivalent in other cereal, eight almonds, half dozen English walnuts, one and one-half lumps of sugar, etc.

TABLE OF FOODS GIVING THE WEIGHT (IN GRAMS, OUNCES AND ROUGH MEASURE) OF A "STANDARD PORTION" OF EACH FOOD AND THE NUMBER OF CALORIES IN THAT "PORTION" IN THE FORM OF PROTEID, FAT AND CARBOHYDRATE.

Name of Food	"Portion" Containing 100 Calories Roughly Described.	Wt. of 100 Calories		Per cent. of		
		Grams.	Oz.	Proteid.	Fat.	Carbohydrate.
COOKED MEATS						
†Beef, round, boiled (fat), 1009§	Small serving	36	1.3	40	60	00
†Beef, round, boiled (lean), 1206§	Large serving	62	2.2	90	70	00
†Beef, round, boiled (med'), 1188§	Small serving	44	1.6	60	40	00
†Beef, 5th right rib, roasted, 1538§	Half serving	18.5	.65	12	88	00
†Beef, 5th right rib, roasted, 1616§	Small serving	32	1.2	25	75	00
†Beef, 5th right rib, roasted, 1615§	Very small serving	25	.88	18	82	00
†Beef, ribs boiled, 1126§	Small serving	30	1.1	27	73	00
†Beef, ribs boiled, 1170§	Very small serving	25	.87	21	79	00
*Calves foot jelly, as purchased		112	4.	19	00	81
*Chicken, as purchased, canned	One thin slice	27	.96	23	77	00
*Lamb chops, boiled, edible portion, average	One small chop	27	.99	24	76	00
†Lamb, leg, roast	Ordinary serving	50	1.8	40	60	00
†Mutton, leg, boiled, 1184§	Large serving	34	1.2	35	65	00
†Pork, ham, boiled (fat) 1174§	Small serving	20.5	.73	14	86	00
†Pork, ham, boiled, 1192§	Ordinary serving	32.5	1.1	28	72	00
†Pork, ham, roasted (fat), 1484§	Small serving	27	.96	19	81	00
†Pork, ham, roasted (lean), 1511§	Small serving	34	1.2	33	67	00
*Turkey, as pur., canned	Small serving	28	.99	23	77	00
†Veal, leg, boiled, 1182§	Large serving	67.5	2.4	73	27	00
UNCOOKED MEATS						
*Beef, loin, edible portion, average (lean)	Ordinary serving	50	1.8	40	60	00
*Beef, loin, edible portion, average (fat)	Small serving	30	1.1	22	78	00
*Beef, loin, porterhouse steak, edible por., av	Small steak	36	1.3	32	68	00
*Beef, loin, sirloin steak, edible portion, av	Small steak	40	1.4	31	69	00
*Beef, ribs, lean, edible portion, average	Ordinary serving	52	1.8	42	58	00
*Beef, round, lean, edible portion, average	Ordinary serving	63	2.2	54	46	00
*Beef, tongue, edible portion, average	Ordinary serving	62	2.2	47	53	00
*Beef, juice		395	14.	78	22	00
*Chicken (broilers), edible portion, average	Large serving	90	3.2	79	21	00
*Clams, round, in shell, edible portion, average	Twelve to sixteen	210	7.4	56	8	36
*Cod, whole, edible portion	Two servings	138	4.9	95	5	00
*Goose (young), edible portion, average	Half serving	25	.88	16	84	00
*Halibut steak, cooked, edible portion, average	Ordinary serving	81	2.8	61	39	00
*Liver (veal), as purchased, average	Two small servings	79	2.8	61	39	00
*Lobsters, whole, edible portion, average	Two servings	117	4.1	78	20	2
*Mackerel (Spanish), whole, edible portion, av	Ordinary serving	57	2.	50	50	00
*Mutton leg, hind, lean, edible portion, average	Ordinary serving	50	1.8	41	59	00
*Oysters, in shell, edible portion, average	One dozen	193	6.8	14	22	29
*Pork, loin chops, edible portion, average	Very small serving	27	.97	18	82	00
*Pork, ham, smoked, lean, edible portion, av	Small serving	36	1.3	29	71	00
*Pork, bacon, smoked, med. fat, edible por., av	Small serving	15	.53	6	94	00
*Salmon (California), ant. sec., ed. por., av.	Small serving	42	1.5	30	70	00
Shad, whole, edible portion, average	Ordinary serving	60	2.1	46	54	00
*Trout, brook, whole, edible portion, average	Two small servings	100	3.5	20	29	00
*Turkey, edible portion, average	Two small servings	33	1.2	29	71	00
VEGETABLES.						
*Artichokes, as purchased, average, canned		430	15	14	0	86
*Asparagus, as purchased, average, canned		540	19	34	5	62
*Asparagus, as purchased, average, cooked		206	7.19	18	63	19
*Beans, baked, canned	Small side dish	75	2.66	21	18	61
*Beans, Lima, canned	Large side dish	126	4.44	21	4	75
*Beans, string, cooked	Five servings	480	16.60	15	48	37
*Beets, edible portion, cooked	Three servings	245	8.7	2	23	75
*Cabbage, edible portion		310	11	20	8	72
*Carrots, edible portion, average, fresh		215	7.6	10	8	82
Carrots, cooked	Two servings	164	5.81	10	34	56
*Cauliflower, as purchased, average		312	11	23	15	62
*Celery, edible portion, average		540	19	24	5	71
Corn, sweet, cooked	One side dish	99	3.5	13	10	77
*Cucumbers, edible portion, average		565	20	18	10	72
*Egg plant, edible portion, average		350	12	17	10	73
Lentils, cooked		89	3.15	27	1	72
*Lettuce, edible portion, average		505	18	25	14	61
*Mushrooms, as purchased, average		215	7.6	31	8	61
*Onions, fresh, edible portion, average		240	8.4	13	5	82
*Onions, cooked	Two large servings	240	8.4	12	40	48
*Parsnips, edible portion, average	One and a half serving	152	5.3	10	7	83
Parsnips, cooked		163	5.84	10	34	56
*Peas, green, canned	Two servings	178	6.3	25	3	72
*Peas, green, cooked	One serving	85	3	23	27	50
Potatoes, baked	One good sized	86	3.05	11	1	88
*Potatoes, boiled	One large sized	102	3.62	11	1	88
*Potatoes, mashed (creamed)	One serving	89	3.14	10	25	65
Potatoes, steamed	One serving	101	3.57	11	1	88
*Potatoes, chips	One half serving	17	.6	4	63	33
*Potatoes, sweet, cooked	Half of av. potato	49	1.7	6	8	86
*Punpkins, edible portion, average		380	12	15	4	81
Radishes, as purchased		480	17	18	3	79
Rhubarb, edible portion, average		430	15	10	27	63
*Spinach, cooked, as purchased	Two ord. servings	174	6.1	15	66	19
*Squash, edible portion, average		210	7.4	12	10	78
*Succotash, canned, as purchased, average	Ordinary serving	109	3.5	15	9	76
*Tomatoes, fresh, as purchased, average	Four av. tomatoes	430	15	15	16	69
Tomatoes, canned		431	15.2	21	7	72
*Turnips, edible portion, average	Two large servings	246	8.7	13	4	83
Vegetable oysters		273	9.62	10	51	39
DAIRY PRODUCTS.						
*Butter, as purchased	Ordinary pat or ball	12.5	.44	.5	99.5	00
*Buttermilk, as purchased	1½ glass	275	9.7	21	12	54
*Cheese, American, pale, as purchased	1½ cubic in.	22	.77	25	73	2
*Cheese, cottage, as purchased	4 cubic in.	89	3.12	76	8	16
*Cheese, full cream, as purchased	1½ cubic in.	23	.81	25	73	2
*Cheese, Neufchatel, as purchased	1½ cubic in.	29.5	1.05	22	76	2
*Cheese, Swiss, as purchased	1½ cubic in.	23	.8	25	74	1
*Cheese, pineapple, as purchased	1½ cubic in.	20	.72	25	73	2
*Cream	¼ ordinary glass	49	1.7	5	86	9
*Kumyss		184	6.7	21	37	42
*Milk, condensed, sweetened, as purchased		30	1.06	10	28	67
*Milk, condensed, unsweetened (evap. cream) as purchased		59	2.05	24	50	26
*Milk, skimmed, as purchased	1½ glass	255	9.4	37	7	56
*Milk, whole, as purchased	Small glass	140	4.9	19	52	29
*Whey, as purchased	Two glasses	360	13	15	10	75
FRUITS (DRIED).						
*Apples, as purchased, average		34	1.2	3	7	90
Apricots, as purchased, average		35	1.24	7	3	90
*Dates, edible portion, average	Three large	28	.99	2	7	91
*Dates, as purchased		31	1.1	2	7	91
*Figs, edible portion, average	One large	31	1.1	3	0	97
*Prunes, edible portion, average	Three large	32	1.14	3	0	97
*Prunes, as purchased		38	1.35	3	0	97
*Raisins, edible portion, average		28	1	3	9	88
*Raisins, as purchased		31	1.1	3	9	88

Name of Food	"Portion" Containing 100 Calories Roughly Described	Wt. of 100 Calories		Per cent. of		
		Grams.	Oz.	Proteid.	Fat.	Carbohydrate.
FRUITS (FRESH OR COOKED).						
*Apples, as purchased	Two apples	280	7.3	3	7	90
Apples, baked		91	3.3	2	5	93
Apples, sauce	Ordinary serving	111	4.1	2	5	93
*Apricots, edible portion, average		168	5.92	8	0	92
Apricots, cooked	Large serving	131	4.61	6	0	94
*Bananas, yellow, edible portion, average	One large	100	3.5	5	5	90
*Blackberries, as purchased, average		170	5.9	9	16	75
Blueberries		170	6.	3	8	89
*Blueberries, canned, as purchased		165	5.8	4	9	87
Cantaloups	Half ord. serving	241	8.6	6	0	94
*Cherries, edible portion, average		124	4.4	5	10	85
*Cranberries, as purchased, average		210	7.5	3	12	85
*Grapes, as purchased, average		136	4.8	5	15	80
Grape fruit		215	7.57	4	4	89
Grape juice	Small glass	120	4.2	0	0	100
Gooseberries		261	9.2	5	0	95
*Lemons		215	7.57	9	14	77
Lemon juice		246	8.77	0	0	100
Nectarines		147	5.14	4	0	96
Olives, ripe	About seven olives	37	1.31	2	91	7
*Oranges, as purchased, average	One very large	270	9.4	6	3	91
Oranges, juice	Large glass	188	6.62	0	0	100
*Peaches, as purchased, average	Three ordinary	280	10.	7	2	91
Peaches, sauce	Ordinary serving	136	4.78	4	2	94
Peaches, juice	Ordinary glass	136	4.80	0	0	100
*Pears	One large pear	173	5.40	4	7	89
Pears, sauce		113	3.98	3	4	93
*Pineapples, edible portion, average		226	8.	4	6	90
Raspberries, black		144	5.15	10	14	76
Raspberries, red		178	6.29	8	0	92
*Strawberries, as purchased, average	Two servings	260	9.1	10	15	75
*Watermelon, as purchased, average		760	27	6	6	88
CAKES, PASTRY, PUDDING AND DESSERTS.						
*Cake, chocolate layer, as purchased	Half ord. square piece	28	.98	7	22	71
*Cake, gingerbread, as purchased	Half ord. square piece	27	.96	6	23	71
*Cake, sponge, as purchased	Small piece	25	.89	7	25	68
Custard, caramel		71	2.51	19	10	71
Custard, milk	Ordinary cup	122	4.29	26	56	18
Custard, tapioca	Two-thirds ordinary	169.5	2.46	9	12	79
*Doughnuts, as purchased	Half a doughnut	23	.8	6	45	49
*Lady fingers, as purchased		27	.95	10	12	78
*Macaroons, as purchased		24	.83	6	33	61
*Pie, apple, as purchased	One-third ord. piece	38	1.3	5	32	63
*Pie, cream, as purchased	One-fourth ord. piece	30	1.1	5	32	63
*Pie, custard, as purchased	One-third ord. piece	55	1.9	9	32	59
*Pie, lemon, as purchased	One-third ord. piece	38	1.33	6	36	58
*Pie, mince, as purchased	One-fourth ord. piece	35	1.2	8	38	54
*Pie, squash, as purchased	One-third ord. piece	55	1.97	10	42	48
Pudding, apple sago		84	3.02	6	3	91
Pudding, brown betty	Half ord. serving	56.6	2	7	12	81
Pudding, cream rice	Very small serving	75	2.65	8	13	79
Pudding, Indian meal	Half ord. serving	56.6	2	12	25	63
Pudding, apple tapioca	Small serving	79	2.8	1	1	98
Tapioca, cooked	Ordinary serving	108	3.85	1	1	98
SWEETS AND PICKLES						
*Catsup, tomato, as purchased, average		170	6.	10	3	87
*Honey, as purchased	Four teaspoonfuls	30	1.05	1	0	99
*Marmalade (orange peel)		28.3	1	.5	2.5	97
*Molasses, cane		35	1.2	.5	0	99.5
*Olives, green, edible portion	Seven olives	52	1.1	1	84	15
*Olives, ripe, edible portion	Seven olives	38	1.33	2	91	7
*Pickles, mixed, as purchased		415	14.6	18	15	67
*Sugar, granulated	Three teaspoonfuls or 1½ lumps	24	.86	0	0	100
*Sugar, maple	Four teaspoonfuls	29	1.03	0	0	100
*Syrup, maple	Four teaspoonfuls	35	1.2	0	0	100
NUTS						
*Almonds, edible portion, average	About eight	15	.53	13	77	10
*Beechnuts		14.8	.52	13	79	8
*Brazil nuts, edible portion	Three ord. size	14	.49	10	86	4
*Butternuts		14	.49	18	82	2
*Cocoanuts		16	.57	4	77	19
*Chestnuts, fresh, edible portion, average		40	1.4	10	20	70
*Filberts, edible portion, average	Ten nuts	14	.48	9	84	7
*Hickory nuts		14	.47	9	85	6
*Peanuts, edible portion, average	Thirteen double	18	.62	20	63	17
*Pecans, polished, edible portion	About eight	13	.46	6	87	7
*Pine-nuts (pignolias), edible portion	About eighty	16	.56	22	74	4
*Walnuts, California, edible portion	About six	14	.48	10	83	7
CEREALS.						
*Bread, brown, as purchased, average	Ordinary thick slice	43	1.5	9	7	84
*Bread, corn (johnnycake), as purchased, av	Small square	38	1.3	12	16	72
*Bread, white, home-made, as purchased	Ordinary thick slice	38	1.3	13	6	81
Corn flakes, toasted	Ord cereal dish full	27	.97	11	1	88
*Corn meal, granular, average		27	.96	10	5	85
*Corn meal, unbolted, edible portion, average		26	.92	9	11	80
*Crackers, graham, as purchased	Two crackers	23	.82	9	20	71
*Crackers, oatmeal, as purchased	Two crackers	23	.81	11	24	65
*Hominy, cooked	Large serving	120	4.2	11	2	87
*Macaroni, average		27	.96	15	1	84
*Macaroni, average, cooked	Ordinary serving	110	3.85	14	15	71
*Oatmeal, average, boiled	1½ serving	159	5.6	18	7	75
*Popcorn, average		24	.86	11	11	78
*Rice, uncooked		28	.98	9	1	90
*Rice, boiled, average	Ord cereal dish	87	3.1	10	1	89
Rice, flakes	Ord cereal dish	27	.94	8	1	91
*Rolls, Vienna, as purchased, average	One large roll	35	1.2	12	7	81
*Shredded wheat	One biscuit	27	.94	13	4.5	82.5
*Spaghetti, average		28	.97	12	1	87
*Wheat flour, entire wheat, average		27	.96	15	2	83
*Wheat flour, graham, average		27	.96	15	2	83
*Wheat flour, patent roller process, family and straight grade spring wheat, average		27	.97	12	1	87
*Zwieback	Size of thick slice of bread	23	.81	9	21	70
MISCELLANEOUS.						
*Eggs, hen's, boiled	One One large egg	58	2.1	32	68	00
*Eggs, hen's, whites		181	6.4	100	0	00
*Eggs, hen's, yolks	Two yolks	27	.94	17	83	00
Omelet		94	3.3	34	60	6
*Soup, beef, as purchased, average		380	13.	69	14	17
*Soup, bean, as purchased, average	Very large plate	150	5.1	20	20	60
*Soup, cream of celery, as purchased, average	Two plates	184	6.3	16	47	37
*Consomme, as purchased		830	20.	85	00	15
*Clam chowder, as purchased	Two plates	230	8.25	17	18	65

† Experiments on Losses in Cooking Meats (1890-93), Grindley, U. S. Department of Agriculture Bull. No. 111.
§ Laboratory number of specimen, as per Experiments on Losses in Cooking Meat.
* Chemical Composition of American Food Materials, Atwater and Bryant, U. S. Department of Agriculture, Bull. No. 28.

To illustrate the method by practical examples, let us suppose that for a particular patient the prescription is for 2,000 calories a day of foods so combined that the food proportions will be represented by a point within the right half of the rectangle. To carry out this prescription the patient looks at the "food map" and finds no foods on it which themselves fall within the prescribed area. He observes, however, that bread and butter are located on opposite sides of this area, and his eye shows him that a combination of the two in equal parts (by calories, not by weight) will very nearly fall within it, though slightly too low. Corn flakes and cream combine within the set limits; milk and dates (a favorite oriental combination) fall near the mark; poached eggs on toast (with the whites left out) will also come near the proper spot, though slightly too high; any cereal foods or fruits (which lie at the left), combined with foods which lie at the right, as egg yolk, nuts or cream, butter, olives or olive oil will combine nearly right, provided the right-hand foods predominate. Choosing such of these combinations as are most relished, the patient eats his meal. Afterward he, his physician or nurse, indicates on the triangle by pencil marks each food which has been eaten, or, if he has a mechanical diet indicator, by the weighted pins. The center of gravity will then show exactly where his meal is located on the "food map," and the total number of "portions" will show how much he has eaten. The cause of any deviation from the prescription will be very apparent. It may be that the point is too high, indicating excessive proteid, and this may be due to too much milk, eggs or meat; or too much cereal food may have displaced the point to the left. These errors may be rectified at the next meal. At the end of the day, from the cards used in the three meals, he selects the three centers of gravity and transfers them to a fourth card, from which, in the same way, the total calories and center of gravity for the three are found; this represents the total day's ration.

Or, again, a patient may at first be given *carte blanche* in his food, merely reporting the "portions" eaten. Each dish being served in "portions," this will require little trouble. In fact, a nurse may do it all by noting what is put on a tray and what is left after the meal. On the basis of the returns, the physician or nurse can tell exactly how much and what proportions

the patient is eating, and his besetting dietetic sins will be evident. The physician will be enabled thereby to guide him intelligently, suggesting, for instance, that he reduce his ration to two-thirds of what he has been accustomed to, or reduce meat, eggs, etc., or take more cream and butter, etc. It goes without saying that any change in diet, unless it be a change in amount only, should be gradual.[9] Thus, if a person has been accustomed to excessive proteid, his stomach has probably become adjusted to this condition and secretes a large amount of gastric juice. When the reduction of proteid is sudden, the gastric juice will not at first decrease in proportion, and a large part of this secretion will therefore remain unused. This uncombined acid interferes with the digestion of starch and the person feels a "sour stomach." A gradual reduction of proteid, on the other hand, will avoid this difficulty. The reduction may be more rapid (for the hyperacid) if the proportion of fat is increased, as fat tends to restrain the gastric secretion.

In the winter of 1906 the mechanical diet indicator was employed for five months in an experiment with nine Yale students. No diet was prescribed, and the indicator was used only to record the diet which the men themselves chose. It was found that by following Mr. Fletcher's rules of thorough mastication and obedience to appetite, the men gradually and naturally reduced their proteid. The extraordinary effects on their working power are described elsewhere.[10] To what extent such "natural eating" can help in pathologic cases has not yet been shown, although some physicians are reported to have found it a very valuable aid in their practice. Certainly it could scarcely fail to be more serviceable than the unintelligent and reckless diet prescriptions so often made.

Whether or not diet prescriptions are given, the actual diet employed by patients should receive study. This study is made easy by means of the graphic and mechanical methods.[11] These methods may be used

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9. Hutchison, Robert: General Considerations on the Therapeutic Uses of Diet, Practitioner, April, 1906, p. 470.

10. For a short abstract see Science, Nov. 16, 1906. A full report will appear in the Transactions of the Connecticut Academy of Arts and Sciences.

11. There is no patent on this device: anyone is free to make and use it. The Battle Creek Sanitarium has had experience in constructing the apparatus. A regular instrument maker may take up its manufacture later if conditions warrant.

with advantage in the kitchen by housewives desirous of supplying balanced meals, and may be of special service in institutions where it is important to provide complete and well-proportioned nourishment at a minimum of cost. On the mechanical diet indicator the weighted pins may be placed to indicate any proposed meal, and this meal, by a slight adjustment of the weights, may be balanced as exactly as desired.

The accompanying table of foods is classified under several heads:

Cooked meats.	Uncooked meats.
Vegetables.	Dairy products.
Fruits.	Nuts.
Sweets and pickles.	Cereals.
Cakes, pastry, puddings and desserts.	
Miscellaneous.	

APPENDIX

The preceding table gives the data for the ordinary foods, in a form most readily used for the graphic or the mechanical method. The figures for carbohydrate are included, although, as has been shown, they do not need to be used in practical application, the location of each food on the "food map" being completely determined by its "latitude" and "longitude," i. e., the proportion of the fuel value in proteid and fat respectively. The foods, so far as possible, are prepared foods such as are served on the table, but unfortunately, the main sources of information being *Bulletin No. 28* of the Department of Agriculture, for food materials, it has not been possible to include all prepared dishes desired. Moreover, recipes vary so that it would be impracticable to supply data for such dishes which could be used with advantage or certainty. It is easily possible, however, for any one who uses the table to add to it the necessary data for any made dish of known recipe. All that is necessary is to translate the weights of the various ingredients into a number of "standard portions," and then to locate these ingredients on the "food map" and find their center of gravity. This will indicate the position of the composite food. The weight of a "standard portion" of this food is found by dividing the aggregate weight of all the ingredients used by the number of "portions" in them, as above ascertained.

Thus, to locate sponge cake, when the recipe is 3 eggs, 1 "cup" (4 oz.) sugar, and 1 "cup" (4 oz.) flour; the eggs, if of ordinary size, weigh 4¼ oz. and constitute, as the table shows, 2 "portions"; the sugar, weighing 4 oz., constitutes 4.65 "portions" and the flour, weighing 4 oz., 4.2 "portions." This gives a total weight of 12¼ oz., and 11 as the total number of "portions." Dividing the former by the latter, we have 1.1 oz. as the weight of a "portion" of sponge cake. The position on the "food map" of sponge cake is now found by

putting the pins at the points on the map as indicated by the table for sugar, eggs and flour. These weights, representing respectively 4.65, 2, and 4.2 "portions," the center of gravity shows the position of sponge cake, which is about 11 per cent. of proteid and about 12 per cent. of fat. This result does not agree exactly with sponge cake as given in the table, owing to the difference in recipe, that in the table probably including shortening.

Unless great precision is required, a sufficient approximation may be obtained in general by omitting fractional portions: thus, we may call the egg 2 "portions," the sugar 5, and the flour 4. The resulting center of gravity may be found roughly by the eye, without even the aid of the diet indicator. It is surprising how close such a rough approximation will usually be found to the true value, as the influence of the errors in the particular ingredients, on the combined result, is small, and the various errors usually tend to offset each other.

Should the reader desire to add other items to the table, either of food materials or foodstuffs, he may do so by using the sources from which the table is constructed. Thus, if he will obtain from the Department of Agriculture *Bulletin No. 28*, "Chemical Composition of American Food Materials," he may translate the figures there given into the form to be entered in the table as follows: The weight in ounces of a "standard portion" is found by dividing 1,600 by the number of calories per pound given in the table. The calories per cent. of proteid is found by multiplying the figure in the *Bulletin* table giving the weight per cent. of proteid, by 1,860 and dividing the result by the figure giving the number of calories per pound. The same calculation and the same factor, 1,860, apply to carbohydrate. For fat the same calculation applies, but with the substitution of the factor 4,220 in place of 1,860. The three results may be verified by adding the resulting figures for proteid, fat and carbohydrate, the sum of which should be 100 per cent. To weigh foods, letter scales will usually suffice, the food being weighed in dishes and the weight of the dishes subtracted.

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INSURANCE COMPANIES AND THE PUBLIC HEALTH

AN ADDRESS BY

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Read Before the Twenty-third Convention of

The International Association of Accident Underwriters

BRETTON WOODS, N. H., SEPTEMBER 20, 21, 22 & 23, 1910

Insurance Companies and the Public Health.

In the history of all forms of insurance we find that at first e conception of insurance is restricted to the one function of trad- g in risks, i. e., selling for a price (called the premium) the chance receiving an indemnity (called the insurance). Later a second nction is almost invariably added, that of *reducing the risks.* Such the natural and inevitable order of development. At first we ist take the risks just as we find them. But sooner or later we cover that risks are more or less preventable and sooner or later befalls that those insurance companies prosper most which prac- e *prevention* as well as *indemnification.* The addition of the pre- nting function at first aroused antagonism as all new ideas do. t it is bound to win wherever prevention is found to pay—which probably everywhere that insurance applies. First one far-sighted mpany sees profits in prevention and then competition compels ers to follow its example or withdraw entirely from the race.

It would seem that marine insurance has stimulated to safe p construction as much as any one factor in the history of ship- lding.

In the history of fire insurance, the mutual companies first de the effort to reduce fire risks. When the importance of ex- ising the function of preventing fires, as well as indemnifying inst fires, once entered into the plans of stock companies, they n overtook, if they did not outrun, the mutual companies. It is imated that the risk from fire in certain particular classes has been uced, through the fire insurance companies, some seventy per t. In New England seventy years ago the rate on cotton and olen mills averaged three or four dollars per hundred. Today se mills are being insured at a total cost per annum of seven ts per hundred. In some cases the cost has been reduced to 1-100 the former amount. This enormous decrease has been accom- hed by slight expenditures. In some factories the cost of im- vements has been more than paid for in the saving of premiums fire insurance in one year. The stock companies were forced by competition of the mutual companies to take up preventive sures. They now employ fire insurance engineers to maintain

laboratory in Chicago which is well equipped for the purpose of tudying fire-resisting materials, fire-resisting devices, and new ap-aratus and fire prevention in general. Many fire insurance men elieve that this laboratory is their best investment. No reduction n rate is guaranteed until fire fighting devices are approved by the aboratory.

I understand that in steam boiler insurance, under the leader-nip of one man, the companies assuming these risks gradually dis-overed that it paid to put back nearly half of their premiums into ne work of inspection of boilers with a view of preventing ex-losions.

In employers' liability insurance, the idea of prevention has ade great headway. Here the companies are all stock companies, it they have learned that their function is not simply to distribute sses, but to lessen them as well.

The same idea of prevention doubtless plays an important part most other forms of insurance, such as live stock insurance, cyclone surance, burglary insurance, plate glass insurance, fidelity in-rance.

Finally the movement toward prevention is now taking pos-ssion of those forms of insurance most vitally connected with uman life,—accident insurance, health insurance and life in-rance.

On February 5th, 1909, I had the honor of addressing the As-ciation of Life Insurance Presidents in New York City on the conomic Aspect of Lengthening Human Life. As a member of resident Roosevelt's Conservation Commission I had just com-eted a report on our National Vitality, Its Wastes and Conserva-on, and as President of the Committee of One Hundred on Na-onal Health I was then, as I am now, actively engaged in an fort to secure a National Department or Bureau of Health. In y address I suggested that the life insurance companies could, ofitably to themselves, and especially to the country, co-operate the health movement now spreading over the whole world. The ssociation appointed a Committee on Human Life Extension, of nich Mr. Ide, President of the Home Life, is chairman. This com-ittee has held several meetings in New York and Washington.

It is a profound satisfaction to have had even a minor part in augurating the movement to introduce prevention into life in-rance, for I am fully persuaded that, sooner or later, life, accident

and health insurance companies will assume their rightful place among the most powerful engines for human safety, health and longevity the world has ever seen.

But, though many have mistakenly thought and said so, I cannot lay claim to being the first to suggest the participation of life insurance companies in the health movement. Mr. Hiram J. Messenger, actuary of the Travelers' Insurance Company, Dr. Burnside Foster, Prof. J. Pease Norton, and I believe many others, had reached the same idea independently. The industrial department of the Metropolitan Life Insurance Company, under the guidance of Mr. Lee K. Frankel, had already laid plans to reduce its mortality.

At present the movement has only just begun; although it has, I believe, gone far enough to demonstrate its wisdom. The Metropolitan has established a consumptive sanatorium for its employees in the face of much opposition and in spite of an adverse decision at first by the Insurance Commissioners of New York State as to their right to do so; it has engaged visiting nurses to co-operate with visiting nurses' associations in certain cities to care for its bed-ridden policyholders; it has established a health magazine to distribute health literature among its policyholders,—which magazine is made available to 15,000,000 readers, or one-sixth of the population in the United States; and it has endorsed in several ways and on several occasions the movement for a National Department of Health.

The Provident Life Assurance Company has established a health bureau which performs two functions, one of issuing bulletins of health information among its policyholders, the other, of granting to those who choose, free medical examinations. At first these free examinations were to occur every two years, but the results were immediately found to be so satisfactory in holding off the Grim Reaper, who was creeping upon his victims unawares, that the interval for periodical examinations has been reduced to one year.

The New York Life Insurance Company has taken a hand in the effort to improve and purify the milk supply of New York City.

Mr. Robert L. Cox, counsel for the Association of Life Insurance Presidents, states that "practically all of the companies represented in the Association of Life Insurance Presidents are giving their moral support to the movement for the prolongation of human life. In addition, many of them are doing practical educative work. Measured by number of policies in force, the Association companies cover 78 per cent. of the field of American companies, having 21,-

700,000 policies out of a total of about 28,000,000. The Association companies engaging in individual work along health betterment lines have 73 per cent. of the total number of policies in force, or 20,500,000."

"There is another group of companies in the Association which goes beyond the body of policyholders in its health promotion activities. They advise impaired applicants for insurance as to their physical condition and make suggestions to aid them. There are four companies in this group. Two of them, in the East, have a total of 86,000 policies. Another is a flourishing Middle West company that has about 150,000 policies. The fourth is a young and conservative Southern company with 7,200 policies."

"One of the Connecticut companies has published suggestions as to health reform in its magazines to agents. Two other companies —one of Massachusetts and the other of California—are considering active work in the future."

The fraternal societies have entered the campaign. Their journal, the *Western Review,* now has a department especially devoted to the public health. Fraternal insurance companies have also in several instances established sanatoria, and have attempted in other ways to lengthen lives and decrease death claims.

The accident companies have, I understand, for some time, aided in getting State laws passed to prevent accidents to life and limb.

Finally, health insurance, one of the youngest forms of insurance, has made a beginning in the field of prevention. The Loyal Protective Insurance Company has, within the last few months, established a health bureau to issue bulletins and conduct a sort of correspondence school of health information. Considering the fact that few, if any, of the existing insurance companies have been engaged in health insurance for more than fourteen years, their present entrance into the field of prevention is unusually prompt. Personally I believe that in health and accident insurance,—and especially in health insurance—there are gigantic possibilities of profit. I use the term profit rather than philanthropy in recognition of the fact that insurance companies as such have no business to undertake philanthropic work except when it is profitable. In the end the money gains made by the insurance companies by reducing mortality and invalidity will be shared by the public in reduced premiums.

My object in this paper is two-fold, (1) to show that the unexploited possibilities of improved safety and health constitute a veritable *bonanza* for insurance companies, and (2) to show some ways in which the insurance companies may begin in the work of exploiting this bonanza.

First, then, What room for improvement is there in the matter of American accidents and ill health? For answer I beg to refer you to my report on National Vitality to President Roosevelt on behalf of his National Conservation Commission. Such reference will save you the trouble of listening to an elaborate statistical argument. In the report referred to it is shown that human life in America could, by the adoption of hygienic reforms already known and entirely practicable, be lengthened over one-third—that is, over fifteen years. This calculation has been made very conservatively and is probably several years inside the truth. The statistics and estimates on which it is based have been taken from published sources, as well as contributed by some score of American authorities—medical, actuarial and hygienic. It is estimated that at least eight years could be added to human life merely by securing reasonably pure air, water and milk.

Now it is well known that mortality and invalidity are very intimately related. Farr attempted to establish a ratio between them. He calculated that for every death each year there was an average of two persons sick throughout the year. But whether or not we can establish a fixed ratio between deaths and invalidity no one will gainsay that they are sufficiently connected to enable us to reason from one to the other. In the absence of good invalidity statistics, mortality may therefore be accepted as a rough barometer of invalidity; and longevity as a rough barometer of vitality and health. We may therefore conclude that the possibility of adding fifteen years to human life carries with it the possibility of adding greatly to human health. If the ratio of disease to death be a fixed one, such extension of human life would reduce invalidity in the same ratio as it would reduce mortality,—which would be, ultimately, about 25 per cent.

There is reason to suspect that the reduction in invalidity would be even more than the reduction in mortality. This may be reasonably inferred from one's general study of the prevention of disease and in particular from the fact that mortality is only preventable up to a certain point—for every one must die some time—whereas disease may perhaps in the millennium be abolished entirely. Pasteur

said: "It is within the power of man to rid himself of every parasiti disease." And if in the distant future disease shall be so much mor preventable than death, it is probably more preventable at ever stage of progress. We feel reasonably safe, therefore, in statin that every success attending our efforts to reduce mortality will b attended by at least equal success in reducing invalidity.

We now know that the death rate is not the fixed and fatalisti thing it was once supposed to be, but that on the contrary it varie according to many known conditions.

The estimates of Finkelburg show that in Europe human lif has doubled in the last 350 years. More recent and more reliable fig ures show that life is lengthening today more rapidly than ever If we take life tables for different periods for England, France Prussia, Denmark, Sweden, and Massachusetts, we find that human life lengthened during the seventeenth and eighteenth centuries a the rate of four years per century; that during the first three quarters of the nineteenth century it lengthened at the rate of about nine years per century; that at present it is lengthening in Europe generally at the rate of 17 years per century, and in Prussia (which is perhaps the home of preventive medicine) at the rate of 27 years per century. For this country the rate can only be judged from the statistics for Massachusetts, which show that life is lengthening by about fourteen years per century, or approximately half of the Prussian rate. These rates may not continue in the future, but the opinion of our best authorities on longevity, such as Ray Lankaster and Metchnikoff, is that there is still great room for improvement, especially after middle life. Hitherto almost all the improvement has been applied to ages before fifty and only the most recent figures show any tendency toward improvement beyond that age.

Recent figures for England show improved mortality at every age of life, and in a September magazine Mr. Lee Frankel tells us that recent statistics for the Metropolitan Life Insurance Company, covering forty-eight million years at risk and over three-quarters of a million death claims, show the following improvement: The death rate of policyholders 20 years of age declined in eleven years from 10.5 per thousand to 7.6; that of policyholders 30 years old from 15.7 to 11.8; of those 40 years old from 19.3 to 14.9. These and other statistics and facts remove entirely the old objection that improved mortality is only to be expected of infants or of those below the ages of policyholders. This improvement is ascribed by Dr. Frankel to

the general movement throughout the United States during the last decade for better tenements, milk, water, etc.

It is significant that backward India—in spite of the enormous room for improvement—shows during twenty years no rate of improvement whatever. Life there remains only half the European span. This is because hygiene is so little practiced.

A fall of the death rate always promptly follows sanitation. Colonel Gorgas cut the death rate in Havana in two, bringing it down to between 20 and 24 per 1,000. The New York death rate responded at once to Colonel Waring's clean streets. And recently it is announced that the death rate of New York is 16.5, the lowest on record—a result, in all human probability, due to the hygienic work of the health officer, the milk reformers and the public agitation for health.

Contrast the death rates from yellow fever at Panama during the efforts of the French to dig the canal and during the American work under the sanitary regulations of Colonel Gorgas!

All evidence points clearly to the value of preventive measures in the conflict with disease. The fall in tuberculosis mortality is directly due to the growing use of hospitals, which have tended to isolate consumptives, and to a use of outdoor life; typhoid fever has virtually disappeared when water and milk supplies have been made pure, the open privy abolished, and flies and other carriers of the specific cause of the disease have been provided against; smallpox has given away before vaccination; yellow fever is fast disappearing now that the agent of transmission is known; while many of the less serious diseases are losing their power, purely owing to preventive measures.

As to the preventability of accidents in the United States, it is only necessary to contrast their frequency here and in Europe. The railroad accidents in this country are not only more numerous than in Europe but many times more numerous, the exact ratio depending on the country and on the method of measuring.

The Commissioner of Labor of Minnesota has stated that in his opinion at least half of all industrial accidents are preventable. Other authorities have expressed similar opinions. There is now very reason to hope that, with the recent establishment of a bureau of mines, the accidents in mining will within a few years show a substantial decrease.

In my report of National Vitality I have collected the estimates of a large number of authorities as to the degree of preventability of 90 causes of death.

On the basis of these figures, the total number of needless, or rather premature, deaths in the United States is estimated at 330,000.

If we accept Farr's conclusion that corresponding to each death here was an average sickness of two years, there are probably constantly ill in the United States about 3,000,000 persons, of whom 00,000 are consumptives. The best authorities agree that at least alf this illness is needless. We have, then, abundant evidence that here is a vast amount of unapplied scientific knowledge capable, when applied, of greatly reducing the number of victims of disease nd death. This knowledge has come suddenly, most of it within a eneration, since the epoch-making work of Pasteur, Lister, Koch, on Behring, Metchnikoff, Chittenden and many others. The modrn laboratory is manufacturing knowledge faster than it is being pplied. Moreover, the rate of increase in hygienic knowledge will oubtless increase rather than decrease in the future. This is the tuation of which insurance companies can now take advantage.

Since life and health insurance companies have to deal with disbility and deaths as questions of dollars and cents, I may add a few ords as to the financial side of the question.

Dr. Farr has estimated the net economic value of an English gricultural laborer at various times of life by discounting his chance f future earnings after subtracting the cost of maintenance. On the asis of tables in my report on National Vitality, it is estimated that ie average value of the lives now sacrificed by preventable deaths is least $1,700. Since the number of preventable deaths is estimated 630,000, the annual waste from preventable deaths is 630,000 times 1,700, or about $1,000,000,000. This represents the annual preentable loss of potential earnings.

We saw that there are always 3,000,000,000 persons in the nited States on the sick list, of whom about 1,000,000 are in the orking period of life and about three-quarters are actually workers id must lose at least $700, which makes the aggregate loss from ness more than $500,000,000. Adding to this another $500,000,-00 as the expense of medicines, medical attendance, special foods, c., we find the total cost of illness to be about $1,000,000,000 per ar, of which it is assumed that at least one-half is preventable. Add-

ing the preventable loss from death, $1,000,000,000, to the preventable loss from illness, $500,000,000, we find one and a half billions as the very lowest at which we can estimate the preventable loss from disease and death in this country. The true figures may well amount to several times this figure, but when statistics are based partially on conjecture, they need to be stated with especial caution.

The cost of conservation is often trifling in comparison with the saving attained. For instance, the hook-worm disease in the South impairs the earning power of its workmen by 25 or 50 per cent. To restore this earning power costs, by curing this disease, on an average, less than $1 for each case. Other examples show that the return on investments in health are often several thousand per cent. per annum. Probably no such unexploited opportunity for rich returns exists in any other field of investment. Mr. Messenger, the actuary, suggests that if insurance companies should combine to contribute $200,000 a year for the purpose of improving the public health, the cost would be one-eighth of 1 per cent. of the premiums, and it would be reasonable to expect a decrease in death claims of much more than 1 per cent. Even this 1 per cent. would make a profit of more than seven times the expense.

Actuaries' tables show that a reduction of one-third in mortality would enable the premium to be reduced by over fifteen per cent.

Dr. Frankel, in the article already referred to, states that through the lessening in mortality which has already been going on without special effort on the part of insurance companies, the policyholders of his company have received back from the company over and above their policy contracts the tidy sum of $23,000,000. Certainly it stands to reason that intelligent and especially concerted action by insurance companies should bear fruit worth many times the cost. In the case of health insurance the saving would be still greater for the reason that the rate of interest does not enter as so disturbing a factor. The insurance men whom I have consulted as to whether it would pay to engage in the saving of lives have been unanimously affirmative in their answers.

The conclusion seems safe that here is a rich unexploited field for saving money. And the beauty of it is that these gains bring with them gains far more precious to the nation than dollars—immeasurable gains of longevity, vitality, efficiency, and happiness. Life, health and accident insurance is not philanthropy but it is a beneficent business. Though at first glance it might seem that to prevent the pollution of streams, to improve the milk supply, to obtain pure foods, and freedom from accident is no part of the business of insurance, yet

it is easy enough to see the very vital connection. By far the larger part of the cost of the insurance business is not management nor agent's fees, but the cost of mortality and invalidity. It is the right, if in fact, it is not the duty, of any business to reduce its cost. To pare down salaries might not save the policyholder one per cent. of his premium, but to reduce mortality cost might save him many per cent.

What, then, can accident and health insurance companies do toward the reduction of accidents and illness? They can follow the example of the Metropolitan, the New York Life, the Provident Life, the Loyal, and other companies, which have already blazed the way, and they can set their experts to study the problem with reference to devising still other methods. Their work of prevention like that of fire prevention can be classified under two heads,—the work of prevention among their own policyholders in particular and the coorperation with public health agencies toward prevention in general. Fire Insurance Companies not only compel or induce their policyholders to take certain precautions against fire, but they act on the community as a whole and stimulate it to provide a proper fire department, proper building laws, etc. In the same way the life insurance companies are now advocating that the Government take up the organization and co-ordination of public health service.

By arousing the Government of the United States, of the States and of municipalities to greater activity, the insurance companies would reap a large share of the benefit without incurring all the cost. In other words, the insured lives would not have to carry the entire load, but could induce the taxpayer to do his share.

To be specific, the Insurance Companies may act in the following ways:

1st. By examination and correspondence they may give specific information or advice to individual policyholders.

2nd. They may diffuse existing knowledge of hygiene—especially of personal hygiene—among their policyholders.

3rd. By investigation, they may discover the ultimate conditions for optimum vitality and safety. With the exception of the investigations of Metchnikoff, very little scientific work is now being done as to the factors of longevity.

4th. By resolutions and by personal representation, they may aid in the passage of laws and regulations for public health and safety, in city, state and nation, and in general cooperate with and give stimulus to all existing agencies for improving human vitality.

Were there time, I should like to go into details in reference to each of these four suggestions. I will, however, confine myself to three specific suggestions to this association as an association. The first is that it appoint a committee consisting of those fittest to construct a workable and detailed scheme for the use of the companies constituting the association. The second is that the association shall by resolution put itself on record as favoring the establishment of a National Department of Health; and third that it authorize the appointment of one or more representatives to attend the future Congressional hearings on Public Health bills.

This is a commercial country and Congress is influenced by the wishes and arguments of commercial organizations. As an offset to the commercial interest opposed to a Department of Health—the food adulterators and promoters of proprietary medicines—the support of Life Accident and Health Insurance Companies has been and will be a strong influence.

President Taft and Ex-President Roosevelt have favored a Bureau of Health and both have reaffirmed this advocacy within a month. The medical profession, the Public Health Association, and associations of State and Territorial Boards of Health, scientific, philanthropic, labor, and grange organizations, and the recent Conservation Congress have advocated the project. It is one of the burning questions of the day and made especially so by the opposition from the quacks and the quack interests. I trust that this association will join with other insurance organizations in the effort to secure a Department of Health worthy of the Nation.

The Life Extension Institute

BY

PROF. IRVING FISHER

of Yale University

MARCH 9, 1914

THE LIFE EXTENSION INSTITUTE

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PROF. IRVING FISHER

of Yale University, delivered at the Annual Banquet
of the Insurance Institute of Hartford, Conn.

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In the history of insurance we find that at first the conception of insurance is restricted to the function of trading in risks, i. e., selling for a price (called the premium) the chance of receiving an indemnity (called the insurance). Later a second function is almost invariably added, that of *reducing the risks*. Such is the natural and inevitable order of development.

The plan of reducing risks through prevention has for many years been followed by the various types of insurance companies such as marine, fire, steam-boiler, cyclone, burglary, plate-glass, accident, etc. When applied to life insurance companies the reduction of risks by prevention means the prevention of disease and death among policy holders. The problem for life insurance companies was therefore (1) whether life could be prolonged; (2) whether its prolongation would cost the insurance companies less than it would return.

As to the first problem, it was once believed that human mortality followed an inexorable law. We now know, however, that the death rate is not the fixed and fatalistic thing it was once supposed to be, but that on the contrary it varies according to many known conditions. The estimates of Finkelburg show that in Europe human life has doubled in the last 350 years. More recent and more reliable figures show that life is lengthening today more rapidly than ever. If we take life tables for different periods for England and France, Prussia, Denmark, Sweden, and Massachusetts, we find that human life lengthened during the seventeenth and eighteenth centuries at the rate of four years per century; that during the first three-quarters of the nineteenth century it lengthened at the rate of about nine years per century; that at present it is lengthening in Europe generally at the rate of seventeen years per century and in Prussia (which is perhaps the home of preventive medicine) at the rate of twenty-seven years per century. For this country the rate can only be judged from the statistics for Massachusetts, which show that life is lengthening by about fourteen years per century, or approximately half of the Prussian rate.

There is no reason why our lives should not be as long as those of our Swedish and Danish brethern across the sea, just as there is no need that the length of life in India should be, as

it is, only half that of Europe and America. It may be Utopian to expect that a hundred years from now human life in Germany will actually be twenty-seven years longer than it is today, but the fact is that such prolongation will occur unless the present rate of progress be slackened.

In my report on "National Vitality" for the Conservation Commission I tried to compute the effects on human longevity of preventing each preventable disease, not on the assumption of total preventability, but on the assumption of partial preventability, the degree being conservatively estimated for me by the best medical experts available. The prolongation of life which, at the very lowest, is certainly attainable, has been worked out from each of ninety causes of death. The total was found to be about *fifteen years*. Undoubtedly this is a low minimum. In selected groups such as apply in life insurance the possible prolongation would be far greater.

The second problem of the insurance companies is whether or not the prolongation of human life will mean a net gain. By far the larger part of the cost of the insurance business is not management, nor agent's fees, but the cost of mortality and invalidity. It is the right, if in fact, it is not the duty, of any business to reduce its cost. To pare down salaries might not save the policy holder 1% of his premium, but to reduce mortality cost might save him many per cent. A dollar saved from reduced mortality will buy a policy holder as much as a dollar returned to him from any other source. If it is wise, just and sound business practice to spend money to guard against impaired lives being insured, it follows that it must be wise, just and sound business practice to spend a reasonable sum annually to keep the policy holder unimpaired as long as possible after he is insured, and for the very same purpose, namely — to prevent a needlessly high mortality average.

The cost of life conservation where it has been practiced outside of life insurance is often trifling in comparison with the saving attained. For instance, the hook-worm disease in the South impairs the earning power of its workmen by 25% or 50%. To restore this earning power costs, by curing this disease, on an average, less than $1 for each case. The investment of the $1 or less is returned to the worker about every working day of his life. Other examples show that the return on investments in health are often several thousand per cent. per annum. Probably no such unexploited opportunity for rich returns exists in any other field of investment.

The late Mr. Messenger, suggested that if insurance companies should combine to contribute $200,000 a year for the purpose of improving the public health the cost would be one-eighth of 1% of the premiums, and it would be reasonable to expect a decrease in death claims of much more than 1%. Even

this 1% would make a profit of more than seven times the expense.

In every life insurance company there is a group of policy holders varying from 3% to 5% of the total, who will accept free medical examinations annually and suggestions as to disease prevention, if the company chooses to supply this life saving service. It is obvious, expecially in view of the favorable mental attitude of these people, that to bring them under health examinations and suggestions will result in lowering the mortality rate in that group.

Nor is it difficult to understand why the cost of this service is readily recovered when we consider how very few lives it is necessary to prolong in order to cover the expense even in a large group. For instance, at a flat rate of $3.00 each the medical examination of a group of 5,000 people annually would cost $15,000. With the average policy at $2,000 the cost of this service would be saved in interest alone, if each life were extended an average of eleven days. That this is far within the limits of reasonable probability is apparent when we note that the entire cost would be thus covered by the prolongation of but 30 lives out of the entire 5,000 examined in varying ratios, e. g., one life being prolonged twenty years; two, fifteen years; four, ten years; six, five years; seven, three years; and ten, one year. This refers to the one item of interest. The premium saved on these 30 lives would amount to more than $5,000.

Bright's disease and other kidney affections alone cost 90,000 lives annually. At least 70% of these lives could be saved or prolonged if these insidious diseases could be detected in their incipiency. And it is a matter of common knowledge that health examinations would readily detect their presence in time to arrest or cure them. Health examinations would prolong enough lives menaced by kidney diseases alone to pay the cost several times over of the periodical health examinations by insurance companies, and the same may be said of heart disease, arterial degeneration and other chronic maladies that can be detected in their early stages by blood pressure tests and other diagnostic methods. In one of the older companies 43% of the deaths were due to these diseases (of the heart, etc.) and 42% of the applications rejected are charged to evidences of these same maladies. The same ratio doubtless holds good in all excepting the younger companies.

The conclusion seems safe that there is a rich unexploited field for saving money. And the beauty of it is that these gains bring with them gains far more precious to the nation than dollars — immeasurable gains of longevity, vitality, efficiency and happiness. The life insurance company that endeavors to reduce sickness and to prolong life renders the very highest form of human service, and wins the warm approval and support of its policy holders and of the public.

The life insurance companies have at last begun to move in this direction. In a short time the movement promises to be general. This will, I believe, mark one of the greatest steps, if not the greatest step, ever taken toward the improvement of human longevity.

As far back as 1905 the Loyal League, a fraternal company, opened a sanatorium for policy holders who should contract tuberculosis. The Modern Woodmen opened a similar sanatorium in 1908. Other fraternal companies have done the same. The Metropolitan was the first old line insurance company to enter this field of welfare work, having established a welfare department under Dr. Lee K. Frankel in 1909. In the same year the Provident Savings, later merged into the Postal, opened a health bureau. This was the first to undertake the work of medical re-examinations of policy holders, a work which will now be continued for this company as for others by the newly-formed Life Extension Institute. The Metropolitan established a sanatorium in 1911, and a District Nurse Service about the same time. The Equitable has had a conservation department for four years under a conservation commissioner, Mr. E. E. Rittenhouse. The Association of Life Insurance Presidents has, since 1909, had a committee on health which has sought in particular to secure the enactment of better state laws governing vital statistics.

The Life Extension Institute is specially organized and equipped to supply an effective life-saving service to life insurance companies at a cost much lower than they could possibly operate such a comprehensive service themselves. Briefly, this service consists of health examinations arranged by the Institute to detect disease in its early stages, when it can be checked or cured, and of an educational program to increase physical efficiency by promoting healthful living and protection against disease. It will deal solely with prevention. Treatment will be left to the family physician. The specific plan regarding life insurance companies will be the forming of contracts with such companies to offer examinations to certain groups of their policy holders at regular intervals.

The Directors of the new Institute are: Ex-President Taft, who, since his experience with tropical hygiene in the Philippines and Panama, has been an enthusiast on the possibilities of modern scientific hygiene; Harold A. Ley, the originator of the plan; Prof. Irving Fisher; Frank A. Vanderlip, President of the National City Bank of New York; E. R. L. Gould, originator of the Model Homes Association; Francis R. Cooley, of Hartford; and Henry H. Bowman, banker, of Springfield, Mass. Dr. Eugene L. Fisk, the well known writer and worker in hygiene, is Medical Director. The Hygiene Reference Board, which will direct the hygienic policy of the company, contains many eminent names, such as Colonel Wm. C. Gorgas, Surgeon General,

U. S. A.; Dr. Rupert Blue, Surgeon General, U. S. P. H. S.; Dr. Harvey W. Wiley, Director, Bureau of Foods, Sanitation and Health, "Good Housekeeping Magazine"; William J. Harris, Director of Census, Washington; Dr. George Blumer, Dean, Yale Medical School; Dr. David L. Edsall, Professor, Clinical Surgery, Western Reserve University; Dr. J. H. Kellogg, Superintendent, Battle Creek Sanitarium; Dr. Victor C. Vaughn, President of the American Medical Association; Dr. Russell H. Chittenden, Professor of Physiological Chemistry; Director, Sheffield Scientific School, Yale University; Dr. William H. Welch, Professor of Pathology, Johns Hopkins University, and President, Maryland State Board of Health; Miss Mabel T. Boardman, Chairman, American Red Cross National Relief Board; Dr. Wickliffe Rose, Director, Rockefeller Sanitary Commission, etc.; Hon. Walter H. Page, Ambassador to England; Dr. Alexander Graham Bell, of the Board of Scientific Directors, Eugenics Record Office.

No single company or group of companies could secure for this purpose the service of such a group of philanthropic, business and scientific men as have volunteered to serve on the Hygiene Reference Board and as Directors of the Institute. This board is already actively at work on its literature and policy.

The advantage of the Life Extension Institute over single companies lies in the fact that in serving a number of companies, the Institute is able to relieve each of the burden of administration and much of the cost thereof. As an expert salaried staff is developed in the larger centers, it will be possible to reduce the cost of the service and a further reduction can be effected by the avoidance of duplicate examinations among those insured with a number of companies having contracts with the Institute. Evidently it would be a saving to life insurance companies if examinations of applicants had been made through one organization. It may be too late now to change the present plan of separate examinations, but this economy can certainly be effected with health examinations by adopting the combined service plan at the start. The companies do not need to form a central bureau. It exists ready to their hand.

We have already made contracts with a few life insurance companies and commercial organizations to examine policy holders and employees and have approached some organizations in Hartford. It is expected that several of the Hartford companies will enter into contract with the Life Extension Institute, but in most cases the matter has not yet progressed to the point where a definite statement can be made. The Connecticut General, however, has definitely promised a contract with the Life Extension Institute to examine all policy holders of over five years' standing.

The Life Extension service of the Institute, beside that offered to policy holders in companies contracting with it, includes provision for health examinations for individuals applying directly, for schools, for members of clubs and similar organizations, for employees of business enterprises. That is, the Institute stands ready to contract with any individuals, or groups of individuals to furnish periodic examinations, supplemented by regular health bulletins. To put it briefly — the Institute will offer the general public a practical life saving service.

The Institute is primarily a philanthropic organization. In order that its service to humanity may be continuous and its existence perpetuated without the aid of charitable contributions the Institute has been organized as a self-sustaining philanthropy. The charges of the Institute are put at the lowest possible point. Two-thirds of any profits above a small rate of interest will be applied to public use in life extension work in preventive fields that a life insurance company itself cannot enter. With the exception of the active administration officers the gentlemen on the Board of Directors and the Hygiene Reference Board donate their services to the Institute as a contribution to human welfare. One special province of the Institute will be to study and promote personal hygiene as distinct from public hygiene. Today, especially in America, personal hygiene is neglected on all sides. In fact, in the United States, it is nobody's business. The duty of making a systematic and scientific study of personal hygiene falls neither to government officers, private institutions, or individuals.

Another most important function from the viewpoint of public service which the Life Extension Institute will perform is in more promptly introducing new advances in hygiene. It will be able to crystalize the best opinion in one authoritative statement that will reach every physician in the country and which every physician in the country will respect from the character of the men sending it forth.

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NATIONAL VITALITY

ITS WASTES AND CONSERVATION

By

IRVING FISHER

Extract from Report of the National Conservation Commission
(Senate Document No. 676, Vol. III, Sixtieth
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PRESENTED BY MR. OWEN

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NATIONAL VITALITY, ITS WASTES AND CONSERVATION.

By Irving Fisher,
Professor of Political Economy, Yale University.

ACKNOWLEDGMENTS.

The materials upon which this report is principally based were collected during the last ten years. They are far from complete, and I had expected to make use of them at my leisure for a series of special articles, but the opportunity which suddenly presented itself of utilizing them in the construction of this report was one which could not be resisted, despite the fact that the time available was only three months. In the endeavor to make the best use of this time I have been compelled in some cases to rely on secondary sources of information. The number of such cases has been greatly reduced, however, through the kindness of colleagues, friends, and correspondents who were appealed to for suggestions, criticisms, and supplementary material. I am greatly indebted to Prof. Lafayette B. Mendel, of the Sheffield Scientific School of Yale University, for helpful comments and detailed criticism of the whole report, and especially of those parts relative to the physiology of nutrition; to Prof. Yandell Henderson, for many helpful suggestions; to Prof. Henry W. Farnam, for suggestions regarding the topics of industrial conditions; to Prof. M. V. O'Shea, of the University of Wisconsin, for carefully revising the major part of the section on school hygiene; to Dr. Charles Wardell Stiles, Chief of the Division of Zoology, Hygienic Laboratory, United States Public Health and Marine-Hospital Service, for information on the extent and burden of the hook-worm disease; to Surg. Gen. Robert M. O'Reilly, of the United States Army, for statistics of army hygiene; to Dr. Prince A. Morrow, of New York City, and to Prof. C. R. Henderson, of the University of Chicago, for carefully prepared notes in regard to "the social evil."

I am indebted to Dr. Herbert E. Smith, dean of the Yale Medical School, for general criticism; and to his colleagues, Profs. Joseph M. Flint, George Blumer, H. L. Swain, and Oliver T. Osborne, for criticism and aid, both general and special.

Among the many others who have rendered very valuable assistance I would especially mention Dr. J. H. Townsend, secretary Connecticut state board of health; Dr. Cressy L. Wilbur, Chief of Division of Vital Statistics, Bureau of the Census; Col. W. C. Gorgas, chief sanitary officer, Isthmian Canal Commission; Dr. J. N. Hurty, secretary of the state board of health of Indiana; Dr. Charles V. Chapin, city health officer, Providence, R. I.; Dr. George H. Simmons, of Chicago, secretary of the American Medical Association; Dr. J. N. McCormack, lecturer of the American Medical Association; Dr. William J. Mayo, formerly president of the American Medical Association; Dr. Henry P. Walcott, president Massachusetts state

board of health; Prof. F. F. Wesbrook, dean of the Medical School of the University of Minnesota; Dr. Henry B. Baker, ex-secretary Michigan state board of health; Dr. William C. Woodward, health officer of the District of Columbia; Dr. George M. Kober, dean of Georgetown Medical College; Dr. Norman E. Ditman, of Columbia University; Dr. J. H. Kellogg, superintendent of the Battle Creek Sanitarium, and his assistants, Dr. J. T. Case and Dr. W. H. Riley; Dr. Richard C. Newton, of Montclair, N. J.; Dr. Luther H. Gulick, of New York City; Dr. W. G. Anderson, director Yale gymnasium; Dr. Charles H. Castle, of Cincinnati, Ohio; Dr. J. P. C. Foster, of New Haven; Prof. Russell H. Chittenden, director of the Sheffield Scientific School of Yale University; Leo F. Rettger, assistant professor of hygiene, Yale University; Dr. George M. Gould, of Ithaca, N. Y.; Dr. Helen C. Putnam, of Providence, R. I.; F. B. Sanborn, of Cambridge, Mass.; Hiram J. Messenger, actuary of the Travelers Insurance Company, Hartford; Mrs. Ellen H. Richards, of the Massachusetts Institute of Technology; Mrs. Frank P. Kinnicutt, of New York City; and William H. Tolman, of the Museum of Safety and Sanitation, New York City.

To the help received from these persons will be due in large measure whatever of value this report may have. I could not, single-handed, have done justice to even a portion of the subject. Except for a few statistical monographs and papers cited in it, I have contributed little original material. It has been my task to interpret material brought together from many sources. Despite all the aid received, I am aware that the report abounds in sins of omission. Great pains have been taken to avoid those of commission. Doubtful material has been eliminated so far as possible, and where exact figures were unobtainable, every effort has been made to see that the statements made should be cautious and conservative.

For aid in the difficult work of incorporating into the manuscript the numerous suggestions received, I am indebted to Profs. J. Pease Norton, William B. Bailey, Fred R. Fairchild, and Dr. L. W. Zartman, of the economic department of Yale University; and to Dr. H. M. Scarborough, of the Yale Medical School, and Dr. F. B. Standish, of New Haven. For criticisms on the form of presentation, I am indebted to Mr. Edwin Bjorkman, of New York City; to Mr. Michael Williams, of Oak Bluffs, Mass.; and to Mr. Herbert A. Smith, of the U. S. Forest Service.

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IRVING FISHER.

YALE UNIVERSITY, *November, 1908.*

SUGGESTIONS FOR READERS.

In order that this report may be read and used as widely as possible, it has been arranged with reference to five classes of readers:

1. The "Contents by sections," the index, and the page headings will facilitate the use of the report for reference purposes.

2. The "Abstract" is chiefly intended for those who have no time to read more.

3. The "Summary" is a somewhat fuller résumé.

4. The "Summary" is also designed to enable those who so desire to read some parts of the report more fully than others. To this end the "Summary" is arranged to correspond to the main report, chapter by chapter and section by section. The reader who, after reading any particular part of the "Summary," wishes to read the corresponding part of the main report has only to turn to the chapter or section having the same number.

5. Those who read the entire report will probably prefer to read the "Summary" or "Abstract" last.

ABSTRACT.

The problem of conserving natural resources is only one part of the larger problem of conserving national efficiency. The other part relates to the vitality of our population. The two parts are closely interwoven. Protection against mining accidents, forest fires, floods, or pollution of streams prevents not only loss of property, but loss of life. The prevention of disease, on the other hand, increases economic productivity.

So far as we can compare vital and physical assets as measured by earning power, the vital assets are three to five times the physical. The facts show that there is as great room for improvement in our vital resources as in our lands, waters, minerals, and forests. This improvement is possible in respect both to the length of life and to freedom from disease during life.

Contrary to common impression, there is no iron law of mortality. Recent statistics for India show that the average duration of life there is less than twenty-five years. In Sweden it is over fifty years, in Massachusetts forty-five years. The length of life is increasing wherever sanitary science and preventive medicine are applied. In India it is stationary. In Europe it has doubled in three and a half centuries. The rate of increase during the seventeenth and eighteenth centuries was about four years per century, during the first half of the nineteenth century about nine years per century, during the latter half of the nineteenth century about seventeen years per century, and in Germany, where medical and sanitary science has reached the highest development, about twenty-seven years per century. The only comparative statistics available in this country are for Massachusetts, where life is lengthening at the rate of about fourteen years per century, or half the rate in Germany.

There is no need, however, of waiting a century for this increase. It could be obtained within a generation. Three-fourths of tuberculosis, from which 50,000 Americans die annually, could be avoided. Eighteen experts in various diseases, as well as vital statisticians, have contributed data on the ratio of preventability of the ninety different causes of death into which mortality may be classified. From these data it is found that fifteen years at least could be at once added to the average human lifetime by applying the science of preventing disease. More than half of this additional life would come from the prevention of tuberculosis, typhoid, and five other diseases, the prevention of which could be accomplished by purer air, water, and milk. In Lawrence, Mass., after the installation of a pure-water supply, the death rate from typhoid was reduced by 80 per cent. For every death thus saved from typhoid, two or three deaths are saved from other diseases.

Judging from the English statistics of illness, we must conclude that at all times in the United States about 3,000,000 persons are seriously ill, of whom about 500,000 are consumptives. Fully half of this illness is preventable.

If we appraise each life lost at only $1,700 and each year's average earnings for adults at only $700, the economic gain to be obtained from preventing preventable disease, measured in dollars, exceeds one and a half billions. This gain, or the lengthening and strengthening of life which it measures, can be secured through medical investigation and practice, school and factory hygiene, restriction of labor of women and children, the education of the public in both public and private hygiene, and through improving the efficiency of our municipal, state, and national health service. Our National Government has now several bureaus exercising health functions, which only need to be concentrated under one department to become coordinated parts of a greater health service worthy of the nation.

SUMMARY.

Summary of Part I.—*Length of life versus mortality.*

SUMMARY OF CHAPTER I—THE LENGTH OF LIFE.

Section 1. *In different places.*—President Roosevelt has pointed out that the problem of conserving our natural resources is part of another and greater problem—that of national efficiency. This depends not only on physical environment but on social environment, and most of all on human vitality. Modern hygiene is the reaction against the old fatalistic creed that deaths inevitably occur at a constant rate. The new motto is that of Pasteur: "It is within the power of man to rid himself of every parasitic disease."

It was once believed that human mortality followed an "inexorable law." Facts, however, show that mortality varies in different places and is decreasing as hygiene comes into use. The length of life in Sweden and Denmark is over fifty years; in the United States and England about forty-five; in India less than twenty-five.

Sec. 2. *At different times.*—In Europe, according to one authority, the length of life has increased in three hundred and fifty years from less than twenty to about forty years; in England, in less than half a century, it has increased about five years; in Prussia, in the last quarter of a century, over six years; in America it has also increased, although good life tables are lacking excepting for insurance experience. The tables for Massachusetts for 1893–1897 show an average duration of life in that State of forty-five years, as compared with forty in 1855, and thirty-five, an estimate of 1789, based, however, on doubtful returns.

SUMMARY OF CHAPTER II—THE MORTALITY RATE.

Section 1.—*Relation of longevity to mortality.*—As duration of life increases the death rate decreases. A death rate is the ratio of the number of deaths in a year to the population. Under normal conditions where the population is "stationary"—that is, neither increasing nor decreasing nor subject to immigration or emigration—the death rate and the duration of life are "reciprocals." In such a population, if the death rate is 20 per 1,000, the duration of life will be $1{,}000 \div 20 = 50$ years.

This relation, however, is disturbed in most countries to-day, and especially in America, by immigration and emigration and by the birth rate being in excess of the death rate. Nevertheless, death rates, if compared under similar conditions, furnish a fairly good index of vitality. They vary in different places and at different times.

Sec. 2. *Mortality in various regions.*—In the registration area of the United States the death rate is 16.5 per 1,000; in France it is 20; in India 42. In different States of the United States it varies from 14 in Michigan to 18 in New York.

Sec. 3. *Urban and rural mortality.*—The death rate is higher in the city than in the country, and the larger the city the higher the death rate. In European countries among the cities with the highest death rate are Dublin (40) and Moscow (37); among the lowest, Frankfort on the Main (16) and The Hague (16).

Sec. 4. *Race and condition.*—The colored death rate greatly exceeds the white. The death rate among the poor exceeds that among the rich, being in Glasgow and Paris over twice as great.

Sec. 5. *Mortality historically.*—Death rates have been decreasing during several centuries. In London, where now the death rate is only 15, it was during the seventeenth and eighteenth centuries 40 to 50, and during 1680 to 1728, a period of pests, it rose as high as 80. Similar reduction has also been experienced in this country. In Habana the death rate after the American occupation fell from over 50 to about 20.

SEC. 6. *Adult and infant mortality.*—The greatest reduction has been effected among children, although the death rate is still undoubtedly high. Statistics show that during the last thirty years the death rate up to 50 years of age has decreased, but that beyond 50 it has remained almost stationary.

SEC. 7. *Particular diseases.*—The mortality from certain special diseases has greatly decreased. The tuberculosis death rate is now in England only one-third of what it was seventy years ago. The death rate from pneumonia now equals that of tuberculosis. Typhoid fever is decreasing. In Munich during 1856 the mortality was 291 per 100,000 of population. The city at that time contained many cesspools. After these were filled up the typhoid rate fell to 10 per 100,000 in 1887, making a reduction of 97 per cent. In Lawrence, Mass., after the public water was filtered in 1893 the typhoid-fever rate fell from 105 to 22. Doctor Kober has shown that death rates from typhoid fever are greatest in cities in which the rivers' waters are polluted, the average for these cities being 62, as compared with 18 for cities using unpolluted water of impounded and conserved streams. Doctor Rosenau concludes that any community having clean water and uninfected milk supply may be free from typhoid.

Smallpox has greatly decreased since vaccination has been employed. In Prussia the death rate per 100,000 from smallpox between 1846 and 1870 was 24. In 1874 vaccination was made compulsory, and the death rate for the years 1875–76 fell to 1.5. Similar figures can be given for other places. The present outcry against vaccination is based on misinformation and on the general reasoning that it is unnatural to introduce a poison into the blood. Statistics show clearly that vaccination decreases smallpox and lengthens life. Even though it were shown that the virus is injurious, it would be the lesser of two evils.

Yellow fever in Philadelphia in 1793 caused the death of one-tenth of the city's population within six and one-half weeks. In 1900 it was found that a species of mosquito transmits this disease. The result of this applied knowledge is that the disease has practically disappeared in America.

SUMMARY OF PART II.—*Breadth of life versus invalidity.*

SUMMARY OF CHAPTER III—PREVALENCE OF SERIOUS ILLNESS.

SECTION 1. *Loss of time.*—Life is shortened by death and narrowed by invalidity. The ideal life, with respect to health, would be free from illness and disability of every kind. To approximate such an ideal is the aim of hygiene. It is usually true that the healthier a life the longer it will last. Humboldt maintained that he had lived four working lives by retaining a working power double the average for double the average number of years. According to Farr, for every death there is an average severe sickness of two years, or for each death per year there are two persons sick throughout the year. This would mean in the United States that, as there are about 1,500,000 annual deaths, there will always be about 3,000,000 persons on the sick list, which is equivalent to about thirteen days per capita.

SEC. 2. *Particular diseases.*—There are constantly ill in the United States of tuberculosis about 500,000 persons, of whom about one-half are totally incapacitated, while the remainder are half incapacitated. The causes of various diseases are closely interwoven. Professor Sedgwick tells us that "Hazen's theorem" shows for every death from typhoid fever avoided by the purification of a polluted water supply two or three deaths are avoided from other causes. Hook-worm disease in the South is a chief cause of incapacitation, especially among the poor whites. For this reason the hook worm has been nicknamed the "germ of laziness." It is believed that a sufferer from hook-worm disease is incapacitated from one-fourth to one-half of the time.

The number of syphilitics in the United States has been estimated at 2,000,000, though from the nature of the case this figure is chiefly conjecture. The social diseases, syphilis and gonorrhea, are responsible for the existence of a large proportion of defectives of various kinds which fill our institutions. Among the troops in the Philippines the venereal morbidity, during the year 1904, was 297 per 1,000, largely exceeding the morbidity from malarial fevers and diarrhea, as 22 out of every 1,000 soldiers were constantly ineffective from venereal disease—four times as many as from any other disease. The statistics outside of army and navy service are impracticable, but there is some reason to believe that they might show an even larger morbidity. The social diseases, which certainly are preventable, are one of the gravest of the menaces to national efficiency.

American railways in 1907–8 killed nearly 11,800 and injured nearly 111,000 persons. The deaths and disablements from accidents in industry, although less carefully recorded, also represent a great and needless impairment of efficiency.

SUMMARY OF CHAPTER IV—PREVALENCE OF MINOR AILMENTS.

SECTION 1. *Importance of minor ailments.*—Minor ailments are far more common than most persons realize. They are chiefly functional disorders, such as of the stomach, heart, nerves, liver, kidney, etc. These deserve more attention than they have hitherto received, because they are the gateway to more serious troubles. For instance, those who neglect colds, or what seem to be colds, will be far more likely to become victims of tuberculosis or pneumonia. No statistics of the prevalence of minor ailments exist. Physicians, whose experience gives them good opportunity to judge, place the time lost annually for each person from minor ailments at three or more days a year.

SEC. 2. *Preventability of minor ailments.*—Practically all minor ailments can be avoided by proper hygiene, public and private. Neurasthenia, so common in America, is one of the most serious and insidious introductions to grave disorders, and is usually due to needless worry or failure to have adequate recreation.

SUMMARY OF CHAPTER V—PREVALENCE OF UNDUE FATIGUE.

SECTION 1. *Strength, endurance, and fatigue.*—Strength is measured by the force a muscle can exert once; endurance by the number of times it can repeat an exertion requiring a specified part of the strength. Fatigue is a chemical effect, due to "fatigue poisons." Far greater differences exist between different persons in respect to endurance than in respect to strength. Some "well" people become tired by a short walk, while others withstand hours of walking, running, or climbing.

SEC. 2. *Alcohol and fatigue.*—The "Committee of Fifty" found that alcohol gives no persistent increase of muscular power. It is well understood by all who control large bodies of men engaged in physical labor that alcohol and effective work are incompatible. Rivers, writing on the influence of alcohol on fatigue, found that when workmen were provided with a moderate amount of wine it resulted in a considerable diminution of their capacity for work.

SEC. 3. *Tobacco and fatigue.*—Athletes recognize that smoking interferes with one's "wind" or "staying power." "Inhaling" tobacco smoke brings carbon-monoxide directly into the blood stream. It is found that smoking increases blood pressure, which fact possibly partly explains the reduction in endurance.

SEC. 4. *Diet and fatigue.*—When excessive amounts of the protein element in food (exemplified in white of egg or the lean part of meat) are taken, they putrefy in the large intestine, producing "auto-intoxication." For this and other reasons, there is a present tendency among physiologists to advise a reduction in the use of such foods from the amounts customary in many countries, and especially in the United States. Auto-intoxication induces fatigue. The endurance of those using high protein and of those using low protein shows in general, although with some exceptions, that the former have less endurance than the latter. Whether the latter are vegetarian or not does not seem to matter. Experiments show that thorough mastication leads instinctively to a reduction in protein.

SEC. 5. *Exertion and fatigue.*—Oxygen, whether taken naturally or artificially, increases the capacity for exertion. A judicious amount of exercise is perhaps the chief factor in producing the highest state of muscular efficiency. Physical training, comprising exercise and other hygienic measures, will probably make the capacity to withstand great exertion three or four times that possessed by most persons.

SEC. 6. *The working day.*—The present working day, from a physiological standpoint, is too long, and keeps the majority of men and women in a continual state of overfatigue. It starts a vicious circle, leading to the craving of means for deadening fatigue, thus inducing drunkenness and other excesses. Experiments in reducing the working day show a great improvement in the physical efficiency of laborers, and in many cases results in even increasing their output sufficiently to compensate the employer for the shorter day. Several

examples of such a result exist, but the real justification for a shorter work day is found in the interest of the race, not the employer. One company, which keeps its factory going night and day, found, on changing from two shifts of twelve hours each to three shifts of eight hours each, that the efficiency of the men gradually increased, and the days lost per man by illness fell from seven and one-half to five and one-half per year. Public safety requires, in order to avoid railway collisions and other accidents, the prevention of long hours, lack of sleep, and undue fatigue in workmen.

SEC. 7. *The importance of preventing undue fatigue.*—The economic waste from undue fatigue is probably much greater than the waste from serious illness. This is because the number of fatigued persons is great enough to more than outweigh the fact that the incapacitation from fatigue is relatively small. Moreover, the relatively slight impairment of efficiency due to overfatigue leads to greater impairment from serious illness. A typical succession of events is, first, fatigue, then "colds," then tuberculosis, then death. The prevention of undue fatigue means the arrest at the start of this accelerating chain of calamities.

SUMMARY OF PART III.—*Methods of conserving life.*

SUMMARY OF CHAPTER VI—CONSERVATION THROUGH HEREDITY.

SECTION 1. *Heredity and environment.*—A wise and farsighted economy will lead the nation to conserve its vital resources by every possible method. These resources depend on two primary conditions, heredity and hygiene, or conditions preceding birth and conditions during life. In other words, vitality is partly inherited and partly acquired. A sound physical and mental inheritance is a greater asset than the inheritance of extraneous advantages like wealth. Even in the Old World a degenerate nobility in the end receives less respect than a virile middle class. The effort to improve vitality reaches its highest point in a nation when its health ideals affect marriage.

SEC. 2. *Eugenics.*—Galton, Pearson, and others are attempting to found the new science of "eugenics," by which is not meant any scheme of general governmental interference with marriage, but the gradual establishment in public opinion of fundamental standards. Just as to-day the marriage of brother and sister is unthinkable, Galton suggests that the time may come when marriage which obviously promotes degeneration will be equally tabooed. The result would be, not to make marriage more artificial, but less. Health, beauty, and vitality are much more natural objects of youthful admiration than titles or wealth, which now exercise, for the most part, a baneful influence on marriage. To lessen the esteem for those false attractions and increase that for natural attractions will tend not only to increase the number of healthy marriages, but to give greater importance to natural and normal love. The effect will be felt both in bringing about a larger proportion of marriages among the healthy and a smaller proportion among the unhealthy. It will also lead to a partial segregation by which the healthy will to a large extent marry among themselves, and thus leave the unhealthy either unmarried or compelled to make alliances in their own class. The result will be, in the struggle for race supremacy, that the healthy, thus separated off from the relatively unfit, will have a distinct advantage both in the number of offspring and in their vitality.

SEC. 3. *Eugenics and law.*—The only government influences which have been seriously suggested by eugenists are two: First, the offering of prizes or bounties to couples who conform to certain standards, in the same way as the French Government has encouraged the increase of its population by offering inducements to couples of the poorer class who raise seven or more children; second, to prevent marriage alliances among criminals, paupers, and the feeble-minded. Some laws on these subjects already exist in Connecticut, Michigan, and especially Indiana, where there is a prohibition of marriage of all persons suffering from transmissible diseases. It is also now provided in Indiana that confirmed criminals, imbeciles, and rapists, when it is deemed advisable by experts, shall be unsexed. What such laws might accomplish may be judged from the history of two criminal families, the "Jukes" and the "Tribe of Ishmael." Out of 1,200 descendants from the founder of the "Jukes" through seventy-five years, 310 were professional paupers, who spent in all two thousand three hundred years in poorhouses, 50 were prostitutes, 7 murderers, 60 habitual thieves, and 130 common criminals. The loss of potential usefulness, cost of

prosecutions, expense of maintenance of jails, etc., Dugdale estimated to be $1,300,000 in seventy-five years, or over $1,000 for each member of the family. All these unfortunate results could have been avoided had the original criminals in this family been sterilized under a law like that of Indiana.

We have the more agreeable record of excellent human qualities inherited through successive generations in the Darwin, Hohenzollern, and other families.

SUMMARY OF CHAPTER VII—CONSERVATION THROUGH PUBLIC HYGIENE.

SECTION 1. *Municipal hygiene.*—The benefits of improved heredity can be enjoyed only by future generations. But we of the present day may conserve our vital resources through hygiene, practiced in one or all of three ways—public, semipublic, and personal hygiene. The first refers to governmental regulation of health, the second to the professional or institutional care of health, and the third to the private life of the individual and the family. Every city now has its health board, yet few citizens realize that the protection rendered by these boards is more important than the protection by the police or fire departments. Much as is done by these boards, there is enormous room for improvement, both in making regulations and in enforcing them by the aid of a more enlightened public opinion. The abatements of the nuisance and menace from spitting and from vitiation by smoke are cases in point. Pure air is one of the primary necessaries of life, but only a small fraction of our countrymen actually enjoy this boon. To this end proper drainage and garbage removal and clean streets are needed. The transmission of disease by insects, flies, and vermin needs to be checked. A constant cause of mortality, among infants especially, is an impure milk supply. The same danger exists in other dairy products, cream, butter, cheese, and ice cream. In Washington, owing apparently to the enactment of a law in 1895 regulating the sale of milk, the death rate from diarrhea and inflammation of the bowels among children under 2 years of age was reduced from 160 or 170 to 135, then 109, 104, and in 1906 to 97. Similar reports come from many other cities in this country and abroad.

SEC. 2. *State hygiene.*—The regulation of the labor of women and children is usually a state matter. It has been suggested by Doctor Stiles that every woman should be allowed once a month to leave a factory without being asked questions or losing wages. The employment of mothers before and after childbirth should be prohibited, as it is now in a number of European countries. This single reform would help greatly to conserve the vitality of the next generation. Child labor in the South is in many cases the lesser of two evils, the other being exposure to the hook-worm disease on polluted farms. In these cases, the abolition of child labor should be preceded by the abolition of hook-worm disease. Hours of labor have been steadily decreasing, and should be decreased further. Accidents are unnecessarily frequent on our American railroads, as well as in industrial establishments. Statistics do not exist for the latter. Special trades have special dangers. Among such trades are those using lead and other dangerous poisonous chemicals, as well as the dust-producing trades which tend to pulmonary troubles. The dark room tenements are a common means in our large cities of depleting national vitality.

SEC. 3. *Federal hygiene.*—This includes quarantine, the inspection of immigrants and exclusion of those with infectious diseases, administration of government hospitals, of pure-food laws and meat inspection, and cooperation with state boards of health in fighting yellow fever, bubonic plague, etc. Federal power needs extension, however. Our interstate railroads should be improved in respect to the sanitation of sleeping cars, smoking cars, etc.

The movement to secure a more intelligent national organization of health is now being pushed by the President, President-Elect, and Members of Congress, and has found expression in the recent platforms of both political parties. What is needed is that the Federal Government should make the national capital a model of sanitation, should provide for more investigation in health matters and the dissemination of information on the prevention of tuberculosis, etc., should cooperate further with state and municipal authorities, and should check the pollution of interstate streams and prevent the transmission of disease-bearing meats or other food from one State to another. Lastly, it should secure, through whatever constitutional means exist, some method of collecting statistical information as to our national mortality and morbidity. Our shortcomings in this respect are now a national disgrace. There is no accurate record of births in any part of the United States, and that of deaths includes less than half our population. As a statistician has said of one of the States,

"It buries its dead people with no more ceremony than it buries its dead dogs." Obviously, no intelligent control of epidemics and other diseases can be made unless the facts in regard to those diseases are known; in other words, unless there exist mortality and morbidity statistics of real value.

SUMMARY OF CHAPTER VIII—CONSERVATION THROUGH SEMIPUBLIC HYGIENE.

SECTION 1. *Medical research and instruction.*—Semipublic hygiene comprises that relating to institutions and the medical profession. The hygiene of the future must depend more on discoveries in preventive medicine than on any other single factor, and institutions such as the Pasteur Institute, the Rockefeller and the Carnegie institutes, and the research laboratories of the Government and universities offer the most promising means of increasing this most useful and practical of all human knowledge. The knowledge is dispensed through medical schools in the training of physicians. These schools are improving so as to introduce more of hygiene and preventive medicine. We are still far, however, from having facilities for training public health officers, or giving them such a degree as D. P. H. (diploma of public health), as is given in England.

SEC. 2. *The medical profession.*—Antiseptic surgery has in the last century been the greatest triumph of the medical profession, and has given it a greater prestige than ever before. It has greatly reduced the mortality from operations, and is illustrated by the figures in army operations. The mortality of the wounded in the Crimean war among English troops was 15 per cent. The mortality in the Transvaal war, 1900–1901, was less than 6 per cent.

In the practice of medicine, the tendency is progressively to give up the use of violent drugs and to depend more on hygiene. Through the modern fight against tuberculosis, physicians have come to prescribe fresh air in their practice generally. They are now turning in like manner to exploit the resources of diet, exercise, bathing, and mental hygiene.

There is danger that these new fields will be preempted by quacks. Many quacks to-day, far from using patent medicines, oppose the use of any drugs whatever. In order that modern hygiene shall be applied by trained physicians, it is necessary that they provide more facilities in this direction. The leaders of the profession are making every effort to raise all members of their profession to their own high standard. This standard not only aims to prevent malpractice and unethical operations, but to set an example to the people in public service and in personal hygienic living.

SEC. 3. *Institutional hygiene.*—Hospitals have done much to prevent disease by segregating infectious cases. Institutions for the deaf and blind and other defectives have led to a better utilization of their powers. Institutional care of the insane has done much, too, but can do more. Mental hygiene as a whole needs to be more carefully studied and taught in all its relations—heredity, alcohol, syphilis, and environment.

The modern sanitarium has become a useful institution for prevention of serious illness, as distinct from the hospital, of which the function has been to cure. Department stores, hotels, and other commercial institutions are installing ventilating and other hygienic apparatus. The churches are also taking part in the health movement, especially the Emmanuel Church in Boston.

SEC. 4. *School hygiene.*—The hygiene of school children is especially important because of its application to human life in its early stages. There is a world-wide movement, led by Switzerland and some other countries of Europe, to obtain and apply knowledge of how to educate the mind without weakening the body. As it is, school children are especially exposed to contagious diseases, which under present conditions often sweep through a whole school before the local health board even hears of it. Quite as serious, if not more so, is the protecting of school children from imperfect seating, lighting, ventilation, and sanitation.

Backward children, with defects of eye, ear, nose, or throat, are numerous, but experiments have shown that the majority could be improved both in intellect and in morals.

In respect to school hygiene, it is not so much lack of knowledge as lack of application of knowledge which is at fault. In order to find and then correct defects of eyes, ears, teeth, etc., and properly apply our knowledge, medical inspection is necessary. Such inspections as have been made disclose an astonishing amount of ill health, the percentage of morbidity being from 20 to 60 per cent. The committee on physical welfare of school children in New

York found that 66 per cent needed medical or surgical attention or better nourishment; 40 per cent needed dental care; 38 per cent had enlarged glands of the neck; 31 per cent had defective hearing; 18 per cent had enlarged tonsils.

Eye strain is a particular evil of civilization, and makes its first appearance in school when the scholar tries to accommodate the eye to the short range which reading requires, but for which the eye mechanism is not well adapted by nature. The evil effects of eye strain are not confined to that organ, but extend to the whole nervous system, and indirectly to the whole organism. Doctor Gould, who has made a special study of this subject, goes so far as to maintain that "eye strain is the chief source of the functional diseases of our citizens."

At present medical inspection is the exception rather than the rule. Only 70 cities in the United States outside of Massachusetts, and 32 cities and 321 towns in Massachusetts, have systems more or less complete. New York employs 150 physicians, who visit each public school once a day to examine children set aside for that purpose by the teacher. In Providence a fresh-air school for children suffering from tuberculosis has been established. The cost of the school per capita is about 50 per cent more than the ordinary schools, but the results justify the expenditure.

Our scholars are being seriously injured by nervous overstrain. Probably this is not because too much work is being required, but because the performance of this work is not accomplished economically. Some experiments seem to indicate that children could accomplish as much intellectually with far less dissipation of nervous energy if they were in the schoolroom about half of the time now spent there. High pressure and long hours are bad economy in schools as in factories.

Playgrounds conserve child vitality and are far superior to formal gymnastics. They provide physical training which accords with child instincts, and keep the child out of mischief and often out of jail. Here, as elsewhere, the suppression by civilized and urban life of the instinct for play and amusement is responsible for much of what we call "crime" and "depravity." In school children should not only be surrounded by hygienic environment, but should be taught the value of hygiene. The suggestion of an annual "health day" or "health week" may prove a fruitful one for this purpose.

SEC. 5. *Voluntary and business organizations.*—Societies to prevent the spread of tuberculosis, social diseases, insanity, etc., or to advocate labor or health legislation (state and national), are now numerous and active. It is being found that philanthropy and profit are not always antagonistic. Labor organizations are connecting the health movement with the eight-hour movement. Farsighted employers are providing social secretaries to watch over the health, comfort, and happiness of their employees, and are often eager for practical suggestions in these matters.

Corporations that have installed apparatus for ventilation and sanitation, even sometimes for the benefit of their machinery rather than their employees, have in known instances gotten back the cost in lessened illness and greater efficiency of work.

An interesting experiment near Paris was that of a mill employing 44 men and 75 women and children. Largely through the services, instruction, and suggestions of a medical officer there was not a single death in three years.

The temperance reform has to-day a powerful impulse in the demands by employers for more efficient labor and by the public for greater safety in travel. Locomotive engineers, conductors, and ship captains who drink can not get employment.

Life-insurance companies may possibly in the future realize their opportunity to make financial gains by participation in the health movement.

Finally, one of the greatest potential agencies for bringing about health reform is the public press. It is already interested and active in the movement, although the good it does is often undone by inserting quack advertising. This not only does direct harm, but often ties the hands of the editor, preventing him from expressing any disapproval of nostrums, however injurious or immoral.

SUMMARY OF CHAPTER IX—CONSERVATION THROUGH PERSONAL HYGIENE.

SECTION 1. *Its importance.*—Personal hygiene is not only of direct importance to the individual, but furnishes the public opinion from which, and from which alone, sound public and semipublic hygiene can spring. Public hygiene will be

ineffective unless supported by personal hygiene. The milk and water supply of a city may be ideal as supplied at a dwelling, but may be carelessly contaminated there. Observation shows that many of the world's most vital men and women have practiced hygiene and often thereby turned weak constitutions into strong ones. Cornaro, the Venetian nobleman, about to die at 37, adopted the "temperate life," taking especial care not to overeat.. He lived to be nearly, or quite, 100.

SEC. 2. *Branches of personal hygiene.*—Personal hygiene comprises hygiene of environment (air, soil, dwellings, clothing), hygiene of nutrition, and hygiene of activity. The ideal conditions of health require purity in air, purity and proper use of food, and a proper balance between mental and physical activity, rest, and sleep. The present world-wide interest in personal hygiene and physical education is not due to any startling discoveries, but to the rediscovery of the importance of truths long insisted upon by the medical profession.

SEC. 3. *The hygiene of environment.*—The prime factor in environment is the atmosphere. Originally man was doubtless an outdoor animal. Civilization has brought him an indoor environment, and with it tuberculosis. Experiments in hospitals have shown that the agitation of the air by dry sweeping greatly increases bacteria. Air in a confined room may be contaminated by chemicals contained in wall paper, plaster, or mortar. The one place in which the individual has most control over his air supply is the bedroom. The fashion now of sleeping with wide-open windows, or even out-of-doors, is certain to improve American vitality. The windows of living and work rooms also may be open even in winter if a window board is used to deflect the air upward and prevent a cold stratum forming on the floor. The outdoor life or the abundant use of fresh air is an almost certain preventive of colds. This fact was commented upon by Franklin over a century ago, and has been rediscovered many times since, especially in the experience of army troops. The evils of bad air are not confined to its chemical content. A room is sometimes "close" simply because it is hot or overmoist or devoid of any air current.

The effect of air on the skin and of radiation of heat from the body is important. Consequently, a proper use of air involves a proper use of clothing, which needs to be both porous and light.

Closely connected with air hygiene is the hygiene of light. "Where sun and air enter seldom the physician enters often." The lighting of dwellings and schoolrooms is especially important with reference to the eyes. This is true also of even the color and texture of the printed page we read. Probably one-fourth of all educated people in America suffer from disturbances due more or less to eye strain and its numerous indirect effects.

SEC. 4. *The hygiene of nutrition.*—The scientific study of diet has only just begun, and few authoritative results can yet be stated. That diet has a distinct relation to endurance has been rendered probable by many investigations, which seem to show in particular that avoidance of overeating, and especially of excess in protein, and thorough mastication are wholesome rules. In the choice of foods the individual must be given a wide latitude. His own instinct, restored and educated by avoiding food-bolting which blunts it, will probably be a truer guide than the wisest of physiologists. Diseased foods, such as oysters polluted with sewage, may transmit typhoid and other maladies.

SEC. 5. *Drug habits.*—Poisons, whether taken into the body or produced within, are injurious. The commonest form of intoxication is alcoholic. Its evils are becoming more apparent than ever before. As Metchnikoff says, it lowers the resistance of the white corpuscles, which are the natural defenders of the body. It predisposes to tuberculosis and numerous other diseases. The findings of the "Committee of Fifty" for the investigation of the liquor problem are important evidence of the evils of the use of alcohol, and these have not received the attention which they deserve. Absinthe in France is being recognized now as a distinct menace to the nation, and in Germany there is a tendency toward a lessened use of alcohol in all its forms. But the movement against the abuse of alcohol has reached its highest point in America.

The evils of tobacco are less and are less appreciated. Its stunting effects on the growing child are especially harmful.

SEC. 6. *Activity hygiene.*—It is an encouraging sign of the times that baths are coming more into vogue, both through the private bath tub for the wealthy and the public baths for the poor. During the last generation the importance of exercise has come to be acknowledged, due largely to the growth of modern athletics. The athletic ideal of the Greeks was, however, higher than that

which now prevails in this country. Overexertion, physical and mental, is one of the chief American faults. The danger signal of fatigue is seldom observed, and the instinct for recreation and amusement is often stifled.

SEC. 7. *Sex hygiene.*—Undue reticence on this subject is responsible for the general ignorance as to the extent to which the abuse of the sex relation is injuring this and every nation, physically, mentally, and morally. Syphilis poisons the blood and affects all parts of the body. It makes the individual a "bad risk" for life insurance companies for several years, and is likely to be transmitted to others through a kiss or through the use of a common towel, while the danger of transmitting from husband to wife, or vice versa, continues for many years. Syphilis is one of the few really hereditary diseases, and the saddest of all facts connected with it is that the guilty parent may escape and the innocent children suffer. Gonorrhœa, while usually cured without apparent impairment of health, destroys fertility, and for years after it has apparently ceased may be rearoused. It is responsible for a large number of the cases of infantile blindness and for a larger percentage of many of the serious troubles of women. The social diseases, while seldom assigned as a cause of death, are known to predispose to other diseases and greatly to shorten life.

SEC. 8. *Personal hygiene in general.*—The cumulative effect of hygiene, or of lack of hygiene, needs emphasis. Breathing, eating, working, and sleeping are matters of daily habit. If they are wrong, the evil, however slight, being repeated every day for many years, produces cumulative effects more subtle, but often more powerful, than the effects of sudden infection or accident.

SUMMARY OF CHAPTER X—ARE HYGIENIC MEASURES EUGENIC?

SECTION 1. *The prolongation of weak lives.*—The question has been raised whether reduction in infant and child mortality will not weaken rather than strengthen the race by interfering with natural selection and favoring the survival of the unfit. It is pointed out that the mortality at later ages of life has not decreased, as has that in the earlier ages. There is probably, however, a sufficient explanation of this in the fact that the improvement in hygienic living has not as yet affected adults as much as children. Parents are quick to apply for the benefit of their children new methods of preventing disease, such as sterilizing milk, but do not take the same precautions for themselves. The hurry and stress of modern life has in fact tended to produce in some respects more unhygienic habits among adults than prevailed under the simpler conditions of a generation ago.

SEC. 2. *Children's diseases impair both fit and unfit.*—It must be borne in mind also that the same children's diseases and other causes which tend to kill the unfit child also tend to injure the proper development of the fit. Consequently a lessening of children's diseases will have the effect of not only prolonging weak lives, but also of prolonging and developing the strong. Statistics, so far as available, appear to show that where infant mortality is the highest, mortality at all ages is high.

SEC. 3. *Fitness is relative to environment.*—What is sometimes called degeneration does not deserve that name. A lessening of physical strength, for instance, can not be called degeneration if conditions under civilization do not require the same physical strength as our barbarian ancestors needed. It is adaptation to existing conditions which measures fitness.

Whatever danger of degeneration there may be from the care of the insane and defective classes can be avoided if the health ideals of the nation are strong and broad enough to meet the situation, for with these high health ideals will come a demand which will prevent the perpetuation of the unfit and through the mere force of public opinion lead in general to healthier marriages.

SUMMARY OF PART IV.—*Results of conserving life.*

SUMMARY OF CHAPTER XI—PROLONGATION OF LIFE.

SECTION 1. *Life is lengthening.*—So far as we can judge from statistics of the average duration of life, it has been on the increase for three hundred and fifty years, and is now increasing more rapidly than ever before. During the seventeenth and eighteenth centuries the increase was at the rate of about four years per century; during the first three-quarters of the nineteenth century the rate was about nine years. At present in Massachusetts life is lengthening at the

rate of about fourteen years per century; in Europe about seventeen; and in Prussia, the land of medical discovery and its application, twenty-seven. In India, where medical progress is practically unknown, the life span is short (twenty-five) and remains stationary.

SEC. 2. *Table showing further practicable prolongation.*—It is possible to estimate the effect on the length of life of the partial elimination of various diseases. Using the statistics, experience, and estimate of 18 physicians as to the preventability of each of the list of 90 causes of death, we find that the length of life could easily be increased from forty-five to sixty, an increase of one-third, or fifteen years. This would result in a permanent reduction in death rate of about 25 per cent. The principal reductions would be from infantile diarrhea and enteritis, over 60 per cent of which could be prevented, with the result of an addition to the average length of life of 2.32 years. Bronchopneumonia, also an infant disease, could be prevented to the extent of 50 per cent, whereby life would be lengthened by 0.60 year. Meningitis, which is usually fatal at the age of two, could be prevented by at least 70 per cent, and this prevention would lengthen the average life by 0.60 year. Eighty-five per cent of death by typhoid fever is unnecessary, and if avoided would lengthen life at least 0.65 year. It would be feasible to prevent at least 75 per cent of cases of tuberculosis of the lungs, and thereby to lengthen life by about two years. If the deaths from violence were reduced only 35 per cent, human life would be increased by 0.86 year. The prevention of 45 per cent of cases of pneumonia would lengthen life by 0.94 year. These seven diseases alone could easily be reduced by these amounts so as to lengthen life by eight years. This could be done simply through insistence by the public on pure milk, pure water, pure air, and reasonable protection from accidents.

SEC. 3. *Diagram showing effect of prolongation at different ages.*—If we take the diagram representing the life table of Massachusetts for 1893–1897, we may use it as the basis for constructing an ideal curve to show the effect of prevention if applied according to the ratios of prevention given in the preceding table. The results agree substantially with those found in the table and show that about thirteen or more years could easily be added to the average duration of life. The diagram also shows the extent to which the additional life would fall in different ages. The per cent of life which would fall to the ages between 17½ and 60, taken as the working period, would remain the same, namely, about 55 per cent.

SEC. 4. *Fifteen years a safe minimum estimate of prolongation possible.*—The estimate of fifteen years is a minimum because, first, it takes no account of future medical discoveries, such as a method of curing or preventing cancer and of postponing old age, as would Metchnikoff; second, it takes little account of the cumulative influence of hygiene. The full benefit of hygiene can not be felt until it is practiced throughout life, and not at the approach of specific danger. Most so-called "causes" of death are merely the last straws which break the camel's back. When a pure water supply prevents deaths from typhoid fever, it prevents two or three times as many deaths from other causes. Third, it takes no account of the racial effects of new health ideals leading, in a general way, as they must, to healthier marriages.

SEC. 5. *Need of lengthening human life.*—With increase of knowledge the period of education or preparation for life must constantly increase. This fact creates a need for a longer life, with the later periods of life increased in proportion. The result of such a prolongation will be not the keeping alive of invalids, but the creation of a population containing a large number of vigorous old men. Metchnikoff says, "The old man will no longer be subject to loss of memory or to intellectual weakness; he will be able to apply his great experience to the most complicated and most delicate parts of the social life."

SEC. 6. *The normal lifetime.*—It is usually recognized that human life is abnormally short, but no exact determination has ever been made of what constitutes a normal lifetime. Flourens maintains that a mammal lives five times the length of its growing period, which would mean, since the growing period for man does not cease until about 30, a normal human lifetime of one hundred and fifty years. Another method of estimating normal life is to reckon the length of normal life as the time when old age now sets in, 83 years. But clearly, if Metchnikoff is right in thinking that old age itself is abnormal, the normal lifetime must exceed 83. Many remarkable cases of longevity are on record, but most cases of reputed centenarians are not authenticated. Drakenburg's record was authentic, and he lived to be 146. Mrs. Wood, of

Portland, Oreg., recently died at 120. To what extent these exceptional case could be made common can not, as yet, be known.

SUMMARY OF CHAPTER XII—THE MONEY VALUE OF INCREASED VITALITY.

SECTION 1. *Money appraisal of preventable wastes.*—Doctor Farr has est mated the net economic value of an English agricultural laborer at various time of life by discounting his chance of future earnings after subtracting the co of maintenance. On the basis of this table we may construct a rough estimat of the worth of an average American life at various ages, assuming that onl three-fourths of those of working age are actually earners of money or hous keepers. It gradually rises from a value of $90 in the first year to $4,200 a the age of 30, and then declines until it becomes negative for the higher age This estimate assumes $700 per year as the average earnings in middle lif This is largely conjecture, but is regarded as a very safe estimate. Applyin this table to the existing population at various ages in the United States, w find that the average value of a person now living in the United States $2,900, and the average value of the lives now sacrified by preventable deatl is $1,700. The latter is smaller than the former because the age of the dyin is greater than the age of the living. Applying the $2,900 to the population eighty-five and a half millions, we find that our population may be valued a assets at more than $250,000,000,000; and since the number of preventab deaths is estimated at 630,000, the annual waste from preventable deaths 630,000 times $1,700, or about $1,000,000,000. This represents the annual pr ventable loss of potential earnings.

We saw in Chapter III that there are always 3,000,000 persons in the Unite States on the sick list, of whom about 1,000,000 are in the working period life and about three-quarters are actually workers and must lose at least $70 which makes the aggregate loss from illness more than $500,000,000. Addin to this another $500,000,000 as the expense of medicines, medical attendanc special foods, etc., we find the total cost of illness to be about $1,000,000,0 per year, of which it is assumed that at least one-half is preventable. Addin the preventable loss from death, $1,000,000,000, to the preventable loss fro illness, $500,000,000, we find one and a half billions as the very lowest at whic we can estimate the preventable loss from disease and death in this countr The true figures from the statistics available may well amount to several time this figure, but when statistics are based partially on conjecture, they need t be stated with special caution.

SEC. 2. *The cost of conservation.*—In Huddersfield the annual deaths of i fants for ten years had been 310. By systematic education of mothers, th number in 1907 was reduced to 212. The cost of saving these 98 lives wa about $2,000, or about $20 each. Gen. Leonard Wood declared that the discove of the means of preventing yellow fever saves annually more lives than wer lost in the Cuban war. The hook-worm disease in the South impairs th earning power of its workmen by 25 or 50 per cent. To restore this earnin power costs, by curing this disease, on an average, less than $1 for each cas These and other examples show that the return on investments in health ar often several thousand per cent per annum. Probably no such unexploited o portunity for rich returns exists in any other field of investment. An actuar suggests that if insurance companies should combine to contribute $200,000 year for the purpose of improving the public health, the cost would be on eighth of 1 per cent of the premiums, and it would be reasonable to expect decrease in death claims of much more than 1 per cent. Even this 1 per cen would make a profit of more than seven times the expense.

SUMMARY OF CHAPTER XIII—THE GENERAL VALUE OF INCREASED VITALITY.

SECTION 1.—*Disease, poverty, and crime.*—Money estimates of waste of li are necessarily imperfect and sometimes misleading. The real wastes can onl be expressed in terms of human misery. Poverty and disease are twin evi and each plays into the hands of the other. From each springs vice and crim Again, whatever diminishes poverty tends to improve health, and vice versa.

SEC. 2. *Conservation of natural resources.*—The conservation of our natura resources—land, raw materials, forests, and water—will provide the foo clothing, shelter, and other means of maintaining healthy life, while the con servation of health likewise tends in many ways to conserve and increas

wealth. The more vigorous and long-lived the race, the better utilization it will make of its natural resources. This will be true for two reasons in particular: First, the greater inventiveness or resourcefulness of vigorous minds in vigorous bodies. Civilization consists chiefly in invention and the most progressive nations are those whose rate of invention is most rapid. Second, the greater foresight and solicitude for the future. As it is usually the normal healthy man who provides life insurance for his family, so it will be the normal healthy nation which will take due care of its resources for the benefit of generations yet unborn.

SUMMARY OF CHAPTER XIV—THINGS WHICH NEED TO BE DONE.

SECTION 1. *Enumeration of principal measures.*—Federal, state, and municipal boards of health should be better appreciated and supported. Their powers of investigation, administration, and disseminating information should be enlarged. School hygiene should be practiced, and personal hygiene more emphasized. The multiplication of degenerates should be made impossible.

INTRODUCTION.

At the conclusion of his White House address on the "Conservation of Natural Resources," President Roosevelt said:

> Finally, let us remember that the conservation of our natural resources, though the gravest problem of to-day, is yet but part of another and greater problem to which this nation is not yet awake, but to which it will awake in time, and with which it must hereafter grapple if it is to live—the problem of national efficiency.

The conditions on which national efficiency depend may be classified under three heads: Those relating to physical environment, those relating to social environment, and those relating to human nature. Under the first head comes the problem of the conservation of land, forests, minerals, and water. The second comprises social questions, whether political, economic, or religious. The third covers the study of the characteristics of man himself—physical, mental, and moral.

This report falls under the third head, concerning as it does vitality, the measure of life itself, and the basis of all human qualities. The object is to review briefly the condition of American vitality, contrasted with the vitality of other nations; to show the extent to which it may be increased; and to point out the value of such an increase in years of life, enjoyment of life, and economic earnings.

The world is gradually awakening to the fact of its own improvability. Political economy is no longer the "dismal science," teaching that starvation wages are inevitable from the Malthusian growth of population, but is now seriously and hopefully grappling with the problem of abolition of poverty. In like manner hygiene, the youngest of the biological studies, has repudiated the outworn doctrine that mortality is fatality, and must exact a regular and inevitable sacrifice at its present rate year after year. Instead of this fatalistic creed we now have the assurance of Pasteur that "It is within the power of man to rid himself of every parasitic disease," as well as the optimistic writings of Metchnikoff and others.

Many evidences of a world-wide awakening to the importance of improving human vitality can be given. Among them are the recent English parliamentary report of the interdepartmental committee on physical degeneration (prompted by the fact that the English army recruits were decreasing in stature); in America, the many societies and congresses to prevent and control tuberculosis, insanity, alcoholism, social diseases and vice, and infant mortality; the growth of preventive sanatoria, dispensaries, and similar institutions; the establishment of numerous journals of preventive medicine, both technical and popular; the increased attention to the subject of health in the public press; the spread of athletics and the physical training movement; the growth of the custom among city people to

organize country clubs, and the increasing popularity of golf and similar recreations; the constant agitation and legislation in reference to child labor, slaughterhouses, impure foods, milk supply, and water contamination; the increased vigilance of health boards; the growth of sick-benefit associations and insurance among working men; the efforts toward improving the sanitary surroundings and hours of labor of workmen, and especially of women and children, and, finally, the movement to secure a national organization of health at Washington.

A number of universities are supporting special investigations in physiology, hygiene, and preventive medicine. Some schools also have placed the allied subjects of domestic science and dietetics on their curricula, while physical education is receiving constantly increasing attention. Within a generation every important college, school, and branch of the Young Men's Christian Association has come to have a gymnasium and classes in gymnastics. Research institutions are being established, such as the Rockefeller Institute for Medical Research, the fund established by Mrs. Sage to study diseases of old age, and the Memorial Institute for Infectious Diseases. The home-economics movement is rapidly growing and seems destined to improve greatly the management of American homes.

The practice of medicine, which for ages has been known as the "healing art," is undergoing a gradual but radical revolution. The change is based on the conviction that an ounce of prevention is worth a pound of cure. As teachers and writers on hygiene, as trainers for athletes, as advisers for the welfare departments of large industrial plants, and in many other directions, physicians are finding fields for practicing preventive medicine. There is a still higher stage of medical science than that of fighting or preventing disease in the individual—the stage which has been called "biological engineering," i. e., the study of the conditions under which the individual may reach his highest efficiency. In the development of this science physicians are turning from private practice to public service and are acting as health officers in federal, state, and city governments, as heads of sanatoria and as medical inspectors of schools, factories, mines, and shops. Even the family physician is in some cases being asked by his patients to keep them well instead of curing them after they have fallen sick.

Finally, we have also the suggestion by Sir Francis Galton of the new science of eugenics, which seeks to study the hereditary conditions of human vitality. He has established a research fellowship on the subject at the University of London. Already Karl Pearson and others have made valuable contributions to the study of human degeneration, the effect of tuberculosis on the race, the comparative number of offspring of various classes, and the extent to which mating is "assortative," so that like marries like.

With all these facts in view it requires no great prophetic vision to see that among the rising generation there will be a great movement to conserve human life and health. The power and success of this movement will depend upon the realization of its stupendous importance. A chief object of this report is, in a conservative and cautious manner, to help make this importance clear.

Part I.—THE LENGTH OF LIFE VERSUS MORTALITY.

Chapter I.—*The length of life.*

Section 1.—*In different places.*

By those who have never considered the problem, death and disease are accepted as a matter of course. In individual cases it is recognized that a death or an illness might have been prevented, but the idea that the death rate could be changed in any appreciable degree, or controlled, is quite foreign to the mind of the average man. Charles Babbage wrote: "There are few things less subject to fluctuation than the average duration of life of a multitude of individuals."[a]

If this statement were correct, we should find the average duration of life[b] and the death rate substantially the same in different places and at different times. The facts do not conform to this view. Modern life tables show that the average length of life in the leading countries of the world varies remarkably, as the following figures will illustrate.[c]

Modern duration of life.

Country.	Males.	Females.
Sweden, 1891–1900	50.9	53.6
Denmark, 1895–1900	50.2	53.2
France, 1898–1903	45.7	49.1
England and Wales, 1891–1900	44.1	47.7
United States (Massachusetts, 1893–1897)[a]	44.1	46.6
Italy, 1899–1902	42.8	43.1
Prussia, 1891–1900	41.0	44.5
India, 1901[b]	23.0	24.0

[a] Samuel W. Abbott, M. D.: "Vital Statistics of Massachusetts for 1897," Thirtieth Annual Report of the State Board of Health of Massachusetts, 1898.

[b] Statistiques Generale de la France: Statistiques Internationales, etc., 1907, p. 566. See also J. A. Baines, "The Peradventures of an Indian Life Table," Journal Royal Statistical Society, 1908, Vol. LXXI, part 2, p. 310, where the average duration of life for males is given as 23.6.

When we consider that the average duration of life in India is scarcely more than one-half that of France and less than one-half

[a] Charles Babbage: A Comparative View of the Various Institutions for the Assurance of Lives, p. 15. London, 1826.

[b] By average duration of life or the life span is meant the average length of life among a large number of persons born taken at random. It is not the same as the average age at death in a community during a year, since that community may contain an abnormally large proportion of infants, or of any other "age group."

[c] Some of the figures, especially those for India, rest on imperfect data, but they are believed to be sufficiently accurate for general comparison.

that of Sweden, we must conclude that the length of human life is dependent on definite conditions and can be increased or diminished by a modification of those conditions.

SECTION 2.—*At different times.*

Striking corroboration of this conclusion is found as soon as we compare the average duration of life at different periods of time. The earliest attempt to discover a law of human mortality appears to be that of Ulpian, a Roman pretorian prefect, about 220 A. D. The meaning of his table is somewhat doubtful, but it is assumed to refer to "expectation of life," which for ages up to 20 is given as thirty years.[a]

This estimate is so crude and vague as to be of little value for comparative purposes. Professor Finkelnburg, of Bonn, estimates that—

> The average length of human life in the sixteenth century was only between eighteen and twenty years, and that at the close of the eighteenth century it was a little over thirty years, while to-day it is between thirty-eight and forty years.[b]

In Geneva the records go back over three centuries showing the following life span:[c]

16th century	21.2
17th century	25.7
18th century	33.6
1801–1883	39.7

Here we see an increase in the span of life of 100 per cent in three or four centuries. The last few decades, moreover, tell a striking story of increase. It is one of the boasts of the nineteenth century that the splendid medical and scientific advances of that period have aided in a distinct lengthening of life.

In 1693 the British Government borrowed money by selling annuities, and in 1790, a century later, it did the same thing. While the first venture proved satisfactory, the second caused a great loss to the Government, owing to the improvement in longevity which had taken place, and which was estimated, for the annuitant class, at 20 years.[d]

If we compare Ogle's English life tables for 1871–1881 with those of Farr for 1838–1854, we find an increase in life span of 1.4 years for males and 2.8 for females.[e]

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[a] See Irving Fisher: Mortality Statistics of the United States Census, Publications of the American Economic Association, Monograph on Federal Census, 1899, p. 157. Taken from Assurance Magazine, VI, p. 314; note.

[b] George M. Kober, M. D.: "Conservation of Life and Health by Improved Water Supply," publications of conference on the conservation of natural resources, 1908, p. 23. Washington, D. C., privately published. From Finkelnburg's "Organisation der öffentl. Gesundheitspflage in der Kulturstaaten" in Handbuch der Hygiene, 1893.

[c] From Mallet in "Annales d' Hygiene," XVII, 169; quoted by Dr. Edward Jarvis, "Political Economy of Health," in Fifth Annual Report, Mass. Board of Health, 1874.

[d] See Dr. Southward Smith, Transactions British Social Science Association, 1857, p. 498, quoted by Dr. Edward Jarvis, ibid.

[e] R. Mayo-Smith; Statistics and Sociology, p. 178. New York (Macmillan), 1895.

A still greater improvement has been effected since Ogle's figures of 1871–1881:

Lifetime in England and Wales:

Males—	
1838–1854	39.9
1891–1900	44.1
Females—	
1838–1854	41.8
1891–1900	47.8

Similar improvements are observable in other countries.

Lifetime in France:	
Males—	
1817–1831	38.3
1898–1903	45.7
Females—	
1817–1831	40.8
1898–1903	49.1
Lifetime in Prussia:	
Males—	
1867–1877	35.3
1891–1900	41.1
Females—	
1867–1877	37.9
1891–1900	44.6
Lifetime in Denmark:	
Males—	
1835–1844	42.6
1895–1900	50.2
Females—	
1835–1844	44.7
1895–1900	53.2
Lifetime in Sweden:	
Males—	
1816–1840	39.5
1891–1900	50.9
Females—	
1816–1840	43.5
1891–1900	53.6

It is difficult to obtain American life tables that go far enough back into history to display increases in the life span similar to those just presented; yet comparisons of Abbott's Massachusetts life tables for 1893–1897 with Elliott's Massachusetts tables for 1855 and Wigglesworth's Massachusetts and New Hampshire life tables of a century ago give us a progressive increase from 35 in 1789[a] to 40 in 1855[b] and 45 in 1893–1897.[c] Unfortunately no tables exist for the United States as a whole from which similar comparisons might be made. Good and reliable vital statistics are among our most crying needs. Meech's life tables, based on the census figures of 1830, 1840, 1850 and 1860, showed a life span for the whole country of 42.[d]

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[a] E. Wigglesworth: "Table showing the probability of the duration, the decrement and the expectation of life in the States of Massachusetts and New Hampshire, formed from 62 bills of mortality on the files of the American Academy of Arts and Sciences in the year 1789." Memoir of the American Academy of Arts and Sciences, Vol. II, p. 133.

[b] Proceedings American Association for the Advancement of Science, 1857, pp. 61 and 69.

[c] Abbott, loc. cit.

[d] Levi W. Meech: System and Tables of Life Insurance, ed. of 1886, pp. 255–259. The figures for life span at different periods given in this paragraph have been secured by averaging the figures for males and females.

The census of 1880 gave some 70 sets of life tables for different registration States and cities. The expectation of life for white males was given for Massachusetts as 44, New Jersey 46, District of Columbia 41, and New York City 33, but in constructing the tables "the census was too prodigal as to quantity and somewhat careless as to quality. It is difficult to separate the wheat from the chaff. The table should have been accompanied by a running criticism. The general defect was that no attempt was made to correct the deficiencies in the returns for infants."[a] The census for 1890 gives only a few life tables, and that for 1900 none.

In striking contrast to these recent increases of the life span in progressive countries is the table for backward India, which showed no advance in twenty years.[b]

Lifetime in India:

Males—	
1881	23.7
1901	23.6

CHAPTER II.—*The mortality rate.*

SECTION 1.—*Relation of longevity and mortality.*

The average duration of life and the death rate[c] are two complementary magnitudes. An increase in the life span means a decrease in the death rate, and vice versa; in fact, in a "stationary" population (a population in which the annual number of deaths equals the annual number of births, and without emigration or immigration), it will be true that the average duration of life and the death rate are mathematically the "reciprocals" of each other.[d] Thus, if the death rate is 20 deaths per annum for each 1,000 of population (i. e., twenty one-thousandths per annum), the average duration of life would be $\frac{1000}{20} = 50$ years.

If this reciprocal relation between duration of life and mortality held true in every population, it would be easy to translate death rates into average duration of life, and conversely; but unfortunately such a simple calculation is impracticable under conditions existing in America, and even in most countries of Europe. With the exception of France, few countries have even approximately an equality between deaths and births and an absence of emigration and immigration. In America, where the deaths are exceeded by the births, and where there is a large immigration of young men and women in the prime of life, the death rate is smaller than it would be if our population were "stationary." The annual death rate in the United

[a] Fisher: Mortality Statistics of the United States Census. American Economic Association Monograph on the Federal Census, 1899, p. 160.

[b] Baines: "The Peradventures of an Indian Life Table," Journal of the Royal Statistical Society, 1908, Vol. LXXL, pt. 2, p. 310.

[c] A death rate is the ratio of the number of deaths during a year to the population, taken at some point in the year, usually the middle.

[d] For a short explanation of this reciprocal relation, which is more fully explained in works on actuarial science, see Fisher: Mortality Statistics of the United States Census, pp. 149–150. It is interesting to see the graphic interpretation of this reciprocal relation by means of the diagram in Chapter XI of this Report.

States is probably about 18 per thousand[a] of population. The reciprocal of this would be 1,000÷18, or 55 years, which is altogether too high an estimate for the average length of life in the United States.

It is possible to "correct" the death rate for "age distribution" so that its reciprocal will be the true average duration of life, but the calculation is a difficult and tedious one. We are forced, therefore, to get along in most cases with the "crude death rate," or the quotient of the number of deaths in a year divided by the population. This figure is much easier to obtain than a corrected death rate or its reciprocal, the average duration of life.

Our data for death rates are far more voluminous than our data for the average duration of life. Although theoretically death rates are not an unerring indication of longevity, they furnish in practice very valuable information. In a general way death rates may be compared with each other, especially in the same community. For instance, a decrease in the death rate in New York City from one year to another is practically a certain indication of improvement in vital conditions.

SECTION 2.—*Mortality in various regions.*

Forty years ago the variations in the death rates of the different sections of Europe were given by Quetelet[b] as follows:

Death rate per 1,000 population.

Northern Europe	24.3
Central Europe	24.5
Southern Europe	29.7

To-day the death rates of various countries compare with each other as in the following table:

Modern death rates per 1,000 of population.[c]

Denmark (1906)	13.5
Sweden (1906)	14.4
England and Wales (1906)	15.4
United States (registration area) (1907)	16.5
Germany (1905)	19.8
France (1906)	19.9
Italy (1906)	20.8
Japan (1905)	21.9
India (males,[d] 1901)	42.3

As we found in the study of duration of life, so we find here wide variations from country to country. Italy presents a death rate larger by nearly one-sixth than that of the United States, while famine-tortured and plague-ridden India's mortality rate is twice that of France and three times the rates of Denmark and of Sweden.

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[a] W. F. Willcox: "Death Rate of the United States in 1900," publications of the American Statistical Association, Vol. X, p. 155.

[b] Quetelet, Physique Sociale, Vol. I, p. 281. These figures refer to the experience of different periods between 1801 and 1831.

[c] With the exception of the figures for India, this table is taken from figures furnished by the Bureau of the Census.

[d] Baines, loc. cit., p. 310.

Even the fairly homogeneous population of our registration States in America shows variations in death rates.[a]

Death rate per 1,000 population in 1900.

Michigan	13.9
Vermont	17.0
Massachusetts	17.7
New York	17.9

The death rate in Michigan, at the one extreme, is thus but three-fourths that of New York at the other extreme. This difference may probably be accounted for in part by the difference in the age constitution, as the population for Michigan contains a larger proportion of population in young and vigorous life than does New York.

SECTION 3.—*Urban and rural mortality.*

Comparison of urban and rural death rates also gives us variations.[b]

Death rates per 1,000 population in 1900.

Massachusetts:	
Urban	17.9
Rural	17.1
Michigan:	
Urban	15.3
Rural	13.3
New Jersey:	
Urban	18.8
Rural	15.5

Interesting comparisons may be made of the death rates of American cities varying in size and location. The death rate per 1,000 of population in 1906 was given [c] as 14.2 (probably incorrect) in Chicago, in Boston 18.9, in New York 18.6, and in Philadelphia 19.3. Cleveland, Ohio, was credited with a death rate of but 16, while Cincinnati, in the same State, had 20.8. The causes of such differences are not always attributable to variations in size. New Haven, for instance, a larger Connecticut city than either Hartford or New London, had a lower death rate in 1900 by 2.2 and 2.5, respectively, per 1,000 population. The differences are accounted for partly by differences in age constitution, partly—it is unfortunately true—by differences in the accuracy of the collected statistics, partly by differences in size and location, and partly by differences in the vigilance of the public and private health authorities.

European cities show even greater variations in mortality than these just given for the United States.

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[a] Twelfth Census of the United States, Vol. III, p. LVIII.
[b] United States Census Bulletin, No. 83, 1901.
[c] Seventh Annual Census Report on Mortality Statistics, 1906.

Death rates of European cities per 1,000 population, 1897.[a]

Locality.	High.	Locality.	Low.
Dublin	39.9	Frankfort on the Main	15.6
Moscow	36.9	The Hague	16.2
Belfast	31.3	Berlin	17
St. Petersburg	31	Amsterdam	17.8

[a] One must doubt, however, the accuracy of some of these figures, especially the Russian. The rates in Moscow and St. Petersburg in 1906 are reported as 25.8 and 25.5, respectively, which do not comport with the rates for 1897.

SECTION 4.—*Race and condition.*

The variations in death rates among different races are well known. The black race, for example, always suffers a higher mortality than the white. In Boston during the half century from 1725 to 1774 the death rate per 1,000 is given as ranging from 56 to 87 for the blacks and only from 30 to 41 for the whites. Thus the maximum white death rate was lower than the minimum black death rate.[a]

In 1906 the death rate per 1,000 in all registration cities having not less than 10 per cent colored inhabitants was 17.2 for whites and 28.1 for blacks.

These racial differences may be ascribed in part to different habits and conditions of life, but probably in part also to varying racial susceptibility to disease.

The relation of social status to the rate of mortality has been often discussed and offers a partial explanation of racial or national variation of death rate. That a well-to-do class, properly fed and clothed and with opportunity for leisure, will be less susceptible to disease and death than a poverty-stricken class, ill-fed and overworked, has been repeatedly shown by statistics. Newsholme has stated,[b] for example, that in Glasgow the death rate among tenants of large houses is much lower than among the tenants of smaller dwellings:

	One and two room houses.	Three and four room houses.	Five rooms and over.
Death rate per 1,000 occupants in 1885	27.7	19.5	11.2

In Paris comparison has been made between two quarters known to be rich, on the one hand, and, on the other, a third quarter known to be poor.

Death rate per 1,000 population.[c]

Rich quarters:	
Elysee	13.4
Opera	16.2
Poor quarter:	
Menilmontant	31.3

[a] Lemuel Shattuck, "The Vital Statistics of Boston," p. xiii. Reprinted in "Bills of Mortality, 1810–1849," city of Boston, 1893.

[b] Arthur Newsholme, "Vital Statistics," London (Swan Sonnenschein), 1899, p. 163.

[c] E. Levasseur, "La Population Francaise," Paris, 1891, Vol. II, p. 403.

In Russia a similar comparison has been made between peasants who own no land, those who own less than 13½ acres, those who own between 13½ and 40½ acres, and so on up the scale of proprietorship.[a]

Peasant death rate per 1,000, Government of Voronezh, 1889–1891.

Class of household.	Per 1,000.
Having no land	34.7
Having less than 13.5 acres	32.7
Having 13.5 and less than 40.5 acres	30.1
Having 40.5 and less than 67.5 acres	25.4
Having 67.5 and less than 135 acres	23.1
Having more than 135 acres	19.2

Occupational comparisons are often made; and while they must be handled with great care, especially because of differences in age, the following may be said to display roughly the variations in death rate among social classes.

Death rate of males per 1,000, according to occupations, for registration States, 1900.[b]

Mercantile and trading	12.1
Clerical and official	13.5
Professional	15.3
Laboring and servant	20.2

Special industries have high death rates from special diseases. Among dusty trades, for instance, tuberculosis is very common.[c]

Finally, the experience of industrial life-insurance companies, which deal largely with the poorer classes of society, shows a higher death rate than that displayed by the experience tables of other insurance companies.[d]

Insurance mortality per 1,000.

Age	Ordinary insurance, English experience.	Industrial insurance, Metropolitan Life.
20	7.3	10.5
25	7.8	14.1
35	9.3	17.2
55	21.7	35.2
70	64.9	91.0

We find also great variations in death rates dependent on varying climatic or seasonal conditions, on the prevalence or absence of certain pests, on the fluctuating virulence of specific diseases, and on numerous natural differences. Other significant factors in mortality are historical events, such as wars, plagues, and epidemics. Hard times bring increased mortality, whether due to natural or politico-economic causes. There remain to be mentioned also deaths by accident in all its many forms.

[a] I. M. Rubinow, "Poverty's Death Rate," publications of the American Statistical Association, December, 1905, p. 348.

[b] "Twelfth Census of the United States," Vol. III, p. cclxi.

[c] See Frederick L. Hoffman, "Mortality from Consumption in dusty trades," Bulletin No. 79 of the U. S. Bureau of Labor.

[d] Haley Fiske, "Industrial Insurance," The Charities Review, March 1898, p. 33.

SECTION 5—*Mortality historically.*

Not only does the death rate vary greatly from place to place and from one social class to another, but it changes in a most marked fashion from period to period in history. The records of old cities show that a decided decrease in mortality has been steadily going on. In London, for example, the rate per 1,000 has fallen from 50 in 1660–1679 to 15 in 1905, a decrease of 70 per cent. In the plague years, 1593, 1625, 1636, and 1665, the death rates per 1,000 were 240, 310, 130, and 430.[a] The "black death" in 1348–9 probably swept away half of the population in many localities throughout Europe.[b]

Mortality in London.[a]

Year.	Rate per 1,000.
1660–1679	50
1680–1728[b]	80
1729–1780	40
1905	15.1

[a] Kober, *loc. cit.*, p. 25.
[b] These years include the period of pests.

Within a quarter century London has cut her death rate in half, while Vienna, if we may trust the figures, has within a century reduced her rate from 60 per 1,000 of population to 23.[c] Similarly, the mortality rate in Boston has been lowered from an estimated 34 per 1,000[d] in 1700 to 19 to-day.

Mr. John K. Gore, actuary of the Prudential Insurance Company, shows[e] that the average death rates per 1,000 of population among typical American cities was, for the white population, as follows:

Years.	Death rate per 1,000.
1804–1825	24.6
1826–1850	25.7
1851–1863	28.3
1864–1875	25.4
1876–1888	22.9
1889–1901	21.0

The record even of the last thirty years displays a fall in death rates that may inspire us with buoyant hope for the future. The mortality rate per 1,000 has fallen in Berlin from 33 in 1875 to 16 in 1904; in Munich, from 41 in 1871 to 18 in 1906; and in Washington, from 28 in 1875 to 19 in 1907.[f]

Between 1890 and 1906 New York lowered her death rate per 1,000 from 25.4 to 18.6, and Boston from 23.4 to 18.9. The mortality rate in the whole registration area of the United States fell from 19.6 per 1,000 in 1890 to 16.1 in 1906, although the area in the last-named year included a larger proportion of urban population.

[a] See Farr, Vital Statistics, London, 1885, p. 131.
[b] See Abbot Gasquet, "The Black Death of 1348 and 1349," London (Bell), 1893.
[c] A. F. Weber, "The Growth of Cities," New York, 1899, pp. 355, 356.
[d] Shattuck, *loc. cit.*, pp. xii-xiv.
[e] "On the Improvement in Longevity in the United States during the Nineteenth Century."
[f] Kober, *loc. cit.*, p. 25.

We have also vital records for the city of Habana, running back over a century. These show that while the death rate in 1802 was given as 54.6 per 1,000, rising in cholera years even as high as 103.4 (1833) and in the last year of Weyler's concentration methods as high as 91, the rate during the eight years from 1899–1906 ranged from 20.4 to 33.6.[a]

These records also show the remarkable and sudden fall that may be brought about by a change in the living conditions of a community. During the three "concentration" years of 1896, 1897, and 1898 the mortality rate per 1,000 was 51.7, 78.7, and 91, respectively. In 1899, the first complete year of American occupation, the rate dropped to 33.6, and since then it has ranged between 20.4 and 24.4. There can be no question that the improvement was almost wholly due to the sanitary reforms introduced by Colonel Gorgas, and the other United States Army surgeons under Gen. Leonard Wood.

The record of American Army sanitarians in the Panama Canal Zone shows as striking results as in Cuba. The death rate in Panama during 1887, when the French canal companies held occupation, ran over 100 per 1,000. In 1906 the death rate was 49 per 1,000, while in 1907 it fell to less than 34. Colonel Gorgas attributes the decrease in the general death rate in great part to improved sanitation, though he adds that "increased wages, better food, and better clothing have no doubt played a considerable part in the general improvement of the health."[b]

Section 6.—*Adult and infant mortality.*

Mortality varies greatly with age. The improvement in the city death rate of the past half century has been especially marked among the young.

It is true that in countries of the same degree of civilization the infant death rate is remarkably constant,[c] but this is probably accounted for by the similarity in the methods of feeding of infants. Certainly where there is a difference in conditions there will be found a difference in mortality. Thus, the comparison between the mortality of infants fed on cow's milk and those fed on mother's milk shows that the former is five to ten times that of the latter.[d]

Although the infant mortality rate is probably falling,[e] the decrease is not accompanied by a lowering of the mortality of later life. There is an increased mortality beyond the age of 50 years. In Massachusetts the death rates by age changed during thirty years as follows:

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[a] "Report of the National Sanitary Department of the Republic of Cuba," Habana, 1906, p. 78.

[b] Letter from Col. W. C. Gorgas, chief sanitary officer, Canal Zone.

[c] See E. B. Phelps, "A Statistical Study of Infant Mortality," quarterly publication of the American Statistical Association, September, 1908. Mr. Phelps shows the utter unreliability of most statistics of infants under 1 year of age, especially in the United States.

[d] See Harald Westergaard, "Mortalität und Morbilität," Jena, 1901, p. 364.

[e] Edward E. Graham, M. D., "Journal of the American Medical Association," September 26, 1908; also "British Medical Journal," February 1, 1908, p. 271.

Death rate in Massachusetts per 1,000 of population in each age period.[a]

Age.	1865.	1895.
5–9	9.6	6.2
10–14	5.1	3.2
15–19	9.6	5.3
20–29	12.6	7.1
30–39	11.7	9.7
40–49	12	13
50–59	17	20
60–69	33	39
70–79	70	82
80 and upward	168	185

[a] "Vital Statistics of Massachusetts," 1856–1895, p. 755.

Here, while the death rate for all age periods under 40 has materially decreased, the later periods of life have suffered progressive increases in mortality rate.[a]

As Frederick L. Hoffman has expressed it:

> There is, of course, no question whatever that the American death rate, using the term in a very comprehensive sense, has substantially declined within the last fifty years, but it is equally evident that this decline has been at the younger ages, and not during the period of life which, economically, is of the greatest value. There is no doubt that the mortality of adult ages is still decidedly excessive.

The same tendency, viewed from the standpoint of the expectation of life,[b] is disclosed in the study of two Massachusetts life tables, compiled nearly a century apart—one, Wigglesworth's life tables for Massachusetts and New Hampshire in 1789, though not very accurate; the other, Abbott's Massachusetts life tables for 1893–1897.

Expectation of life in Massachusetts.

Age.	1789.	1897.	Age.	1789.	1897.
0	35.5	45.4	60	15.4	15.1
10	43.2	50	80	5.9	6.1
20	34.2	42	90	3.7	3.4
40	26	28.2			

These figures indicate that the expectation of life at the earlier ages is much greater than a century ago, but that for the age of 60 and upward it has remained practically stationary.

[a] At first sight it would seem that this increased mortality in later ages could be explained away as due to the larger number of persons who are saved from earlier death and tend to produce a higher mortality at the older ages. I speak of this because very intelligent persons have drawn this conclusion. But it is obviously fallacious, since the figures do not indicate the *number* of deaths in different periods, but the death *rates* in different periods of life per 1,000 at each period. There are, to be sure, as a consequence of saving lives in the past, more old men now living than otherwise there would be, and there will be more deaths, but the figures show that these old deaths have increased faster than the number of old men. This fact raises the suspicion, therefore, that the lives which have been saved by the hygiene of a generation ago are weak lives. Whether this is a tenable hypothesis or not will be discussed in Chapter X.

[b] "Expectation of life" at any given age is the mean after-lifetime of persons who reach that age. Thus 100 persons have an expectation of life of 50 at the age of 10, if the total life to be lived by those 100 persons before death is five thousand years.

English life tables [a] for three decades ending 1900 display the same tendency.

English life tables—Expectation of life.

MALES.

Age.	1871–1880.	1881–1890.	1891–1900.
0	41.4	43.7	44.1
20	39.4	40.3	41
60	13.1	12.9	12.9
80	4.8	4.5	4.6

FEMALES.

0	44.6	47.2	47.8
20	41.7	42.4	43.4
60	14.2	14.1	14.1
80	5.2	5	5.1

These tables show that there is improvement at the younger ages for the period 1891–1900 over the period 1871–1880. For ages over 60 there has been a retrogression. It is observable, however, that between the periods 1881–1890 and 1891–1900 the figures for 60 years have remained stationary, and for 80 have slightly improved.

In other words, a baby to-day has in prospect a much longer average lifetime than did the baby of two generations ago; but a man or woman 60 years old has in prospect an average after lifetime no greater than formerly.

The proximate cause of this contrast would seem to lie in the fact that the mortality from many of the diseases of later life has been and is on the increase. The death rates from diabetes, heart disease, and Bright's disease have all doubled in thirty years.[b]

Cancer is probably on the increase,[c] and "to-day one in every 21 men who have reached the age of 35 and one in every 12 women who have reached 35 eventually die of that disease."[d]

In addition, there may be mentioned other diseases, arteriosclerosis, nephritis, apoplexy, paresis, disorders of the liver, and all manner of degeneration, all of them maladies of adult life, and all of them apparently tending to increase.

Section 7.—*Particular diseases.*

We turn now to the ravages made by particular diseases in the modern world. The death rate in the United States from tuberculosis of all forms equals the combined death rate from smallpox, typhoid fever, diphtheria, cancer, diabetes, appendicitis, and meningitis.

[a] "Supplement to Sixty-fifth Annual Report Register-General of England and Wales," pt. 1, 1907, p. XLVIII–LI.

[b] Norman E. Ditman, M. D., "Education and its Economic Value in the Field of Preventive Medicine," Columbia University Quarterly, Supplement to June, 1908, p. 38.

[c] Elie Metchnikoff, "The Nature of Man," English translation, New York (Putnam), 1903, pp. 213, 214; see also "United States Census mortality statistics, 1906," p. 29.

[d] Ditman, loc. cit., p. 38.

The death rate from tuberculosis of all kinds in the registration area was 183.6 per 100,000 in 1907.[a] The rate is high among negroes.[b] Large as these figures are, they represent a considerable decrease since 1900.[c] Tuberculosis is a preventable disease.

On a par with tuberculosis in the number of its victims in this country stands pneumonia.

The mortality statistics of the last census show that in the registration area of the United States pneumonia is responsible for 11 per cent of all deaths. Pneumonia is now known to be a communicable disease, the germ of which is very widely distributed; but there is great need for special researches into the modes of spreading this formidable disease. In the meantime the best protection is to "keep in condition." While the germ of pneumonia is the exciting cause of the disease, predisposing causes are acute or chronic alcoholism, exposure to cold, extreme exhaustion, and debility of any kind.

Typhoid fever is in some places yielding to preventive measures in a most striking manner. The fall in the death rate from typhoid in the registration area from 46.3 per 100,000 of population in 1890 to 33.9 in 1900,[d] and to 32.1 in 1906,[e] may be safely ascribed to improvements in the water and milk supplies of our cities. The surprising reduction of the typhoid-fever death rate in individual cities, resulting from definite improvements in the water supply, gives direct confirmation of this statement.

The typhoid mortality in Munich during 1856 was 291 per 100,000 of population. The city at that time contained numerous cesspools, and the water supply was largely obtained from wells and pumps. From 1856 to 1887 there was great activity in the filling up of cesspools, the abandonment of pumps and wells, and the installation of modern sewers. A pure water supply was also secured, the water being brought from a distance. The typhoid-fever death rate fell in 1887 to 10 per 100,000 of population—a reduction of 97 per cent.[f]

In Hamburg the typhoid mortality for 1880–1892 ranged from 24 to 88, averaging 39.7 per 100,000. In May, 1893, a filtration plant was opened, and the rate fell in that same year to 18. For the five years following it averaged only 7.2, showing a reduction of over 80 per cent.[g]

The introduction of a water filter in the town of Lawrence, Mass., in 1893 was followed by a reduction in deaths caused by typhoid from 105 in 1892 to 22 in 1896, one-fifth the previous figure. Filter-

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[a] For a careful statistical study of tuberculosis see "Tuberculosis in the United States," United States Census, issued for the International Congress on Tuberculosis, 1908. See also "Bulstrode's Report in Thirty-fifth Annual Report of (English) Local Government Board, 1905–6," and Arthur Newsholme, M. D., "Prevention of Tuberculosis," 1908.

[b] For the prevalence of tuberculosis in the negro, see F. L. Hoffman's valuable monograph, "The American Negro," publications of the American Economic Association, August, 1896.

[c] This decrease is shown by the exact figures (not estimated) in the registration area.

[d] Twelfth Census of the United States, Vol. III, p. cxliv.

[e] Mortality Statistics, U. S. Census Office, 1906, p. 30.

[f] Ditman, loc. cit., p. 17.

[g] A. C. Abbott, M. D., "The Hygiene of Transmissible Diseases," Philadelphia, Saunders, 1899, pp. 88–89.

ing the city water in several other American cities has shown abrupt declines in the typhoid death rate almost as remarkable.[a]

Another method of pointing out the importance of a pure water supply is to compare the mortality rates from typhoid fever of cities that secure water from various sources of supply, as the following table shows:[b]

Death rate from typhoid fever per 100,000 of population, 1902–1906.

4 cities using ground water from large wells	18.1
18 cities using impounded and conserved rivers or streams	18.5
8 cities using water from small lakes	19.3
7 cities using water from Great Lakes	32.8
5 cities using surface and underground water	45.7
9 cities using polluted river water	61.1

Thus far our studies indicate that typhoid fever will cease to be a "problem" in any community having clean water and an uninfected milk supply, and in which cases of the disease are treated as dangerous and contagious."[c]

Unfortunately such communities are too rare at present.

Perhaps the most common and neglected source of danger of infection from typhoid is the ordinary house fly or, as Dr. L. O. Howard, chief of U. S. Bureau of Entomology, would have us call it, the "typhoid fly."

Smallpox, another disease that yields readily to preventive measures, has decreased greatly in virulence and mortality since the introduction of vaccination. In Prussia, for example, the death rate from smallpox per 100,000 population was 24.4 in the period from 1846–1870. In 1874 vaccination, which up to that time had been only intermittently utilized, was made compulsory, and the death rate per 100,000 fell at once to 1.5 for the years 1875–1886.[d]

Other European States, however, have been more lax than Germany. In 1886 the death rate from smallpox in Switzerland was fifty-fourfold that of Germany; in Belgium, forty-eightfold; in Austria, eighty-onefold, and in Hungary, six hundred and sevenfold.[e]

Babbage[f] states that "it has been shown by M. Duvillard that the introduction of vaccination has increased the mean duration of human life about three years and a half." Before Jenner's utilization of vaccination to guard against smallpox that disease was causing one-tenth[g] of all deaths of the human race, just as does tuberculosis to-day, while "nearly twice as many were permanently disfigured by its ravages. In England 300 per 100,000 population died annually from it. It is computed that during the eighteenth century 50,000,000 people died of smallpox in Europe."[h]

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[a] See Kober, loc. cit., pp. 18, 19.
[b] Kober, loc. cit., p. 15.
[c] M. J. Rosenau, L. L. Lumsden, and Jos. H. Kastle, "The origin and prevalence of typhoid fever in the District of Columbia," Hygienic Laboratory Bulletin No. 44, 1908, p. 9.
[d] Ditman, loc. cit., p. 8.
[e] Floyd M. Crandall, "A century of vaccination," American Medicine, December 7, 1901.
[f] Loc. cit., p. 8.
[g] Crandall, loc. cit., p. 6.
[h] Ditman, loc. cit., pp. 6, 52–3.

Boston was visited twelve times by smallpox epidemics in the century and a half ending 1800.[a]

Yet where vaccination has been made compulsory, or where it is generally resorted to, smallpox has virtually disappeared. The last census reported but 3,500 deaths from smallpox in the United States in 1900. Even as long ago as 1826 Denmark was enforcing the practice of vaccination so vigorously that not a single case had appeared for eleven years.[b] Habana, during the eight years prior to the American intervention, reported 3,132 deaths from smallpox. In 1899, the year following the American entry, there were four deaths, and three more during the next seven years—a virtual uprooting of the disease.[c]

The present outcry against vaccination is based on a misunderstanding, and is one of many evidences of the imperative necessity of the diffusion of correct knowledge among the people on matters of hygiene and preventive medicine. Whether vaccination should be made compulsory is a fair question, but that it is efficacious is not open to question. The argument that because some unvaccinated persons escape during an epidemic all would escape is too absurd to deserve serious consideration.[d]

Yellow fever first appeared in serious form at Philadelphia in 1793, when one-tenth of that city's population died of it in the space of six and a half weeks. Since 1793 the United States has had 500,000 cases, resulting, it is estimated, in about 100,000 deaths. In 1900 it was discovered that a species of mosquito is responsible for the transmission of this fever, and in consequence of this knowledge and its application the disease is now practically banished from this country.[e]

The marked decrease in the death rate from yellow fever in Habana since the American intervention in 1898 is shown in the following table. The deaths from yellow fever numbered 4,420 in the eight years from 1891 to 1898, while in the eight years from 1899 to 1906 they numbered but 465.

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[a] Shattuck, loc. cit., p. xiv.

[b] Crandall, op. cit.

[c] Report of National Sanitary Department of the Republic of Cuba, Habana 1906, p. 79.

[d] For the most scientific statistical studies of vaccination see W. R. Macdonnell, Biometrika, Vol. I, 1902, p. 375, and Vol. II, 1903, p. 135. J. Brownlee, Biometrika, Vol. IV, 1905–6, p. 313. F. M. Turner, Biometrika, Vol. IV p. 483. Karl Pearson, Biometrika, Vol. IV, and Philosophical Transactions of the Royal Society of London, Series A, Vol. 195, p. 43. Humphreys, Journal of the Royal Statistical Society, 1897, p. 503. For the best of antivaccination literature see Alfred Russell Wallace, "The Vaccination Delusion," and Milnes Journal Royal Statistical Society, 1897, p. 552 (Comment by G. U. Yale, p. 608) For both sides see Report of the Royal Commission on Vaccination, 1897.

[e] Ditman, loc. cit., pp. 11–12.

Yellow-fever death rate in Habana, 1870–1906.

[Rate per 100,000 population.[a]]

Before American intervention.		After American intervention.	
1870	300.5	1898	67.8
1880	324.5	1899	42.5
1890	153.6	1900	124.0
1895	275.8	1901	6.9
1896	639.5	1902	0
1897	428	1903	0
		1904	0
		1905	8.0
		1906	4.3

[a] Report of the National Sanitary Department of the Republic of Cuba, 1906, p. 79.

These results have been due partly to the elimination of the contagion-carrying mosquito and partly to the general improvement of the city's sanitary appointments.

A similar contrast might be drawn between the death rates from yellow fever at Panama during the efforts of the French to dig the canal and during the American work under the sanitary regulations of Colonel Gorgas. If the same thoroughgoing measures used in Habana and at Panama were employed among our own people, the resultant blessings would be almost equally striking.

The impressive figures just presented, showing the fall in mortality from so many of the most dangerous diseases, point clearly to the value of preventive measures in the conflict with disease. The fall in tuberculosis mortality is directly due to the growing use of hospitals, which have tended to isolate[a] consumptives, and to a use of our recently acquired knowledge of the efficacy of fresh air and the outdoor life; typhoid fever has virtually disappeared when water and milk supplies have been made pure, the open privy abolished, and flies and other carriers of the specific cause of the disease have been provided against; smallpox has given way before vaccination; yellow fever is fast disappearing now that the agent of transmission is known; while many of the less serious diseases are losing their power, purely owing to preventive methods.

Some diseases, once the scourges of humanity, have practically disappeared from the civilized world.

Scurvy up to the latter half of the eighteenth century decimated the armies and fleets of Europe and afterwards proved a menace to the civilized population. During Anson's famous expedition about the year 1750, 600 out of 900 died, chiefly from scurvy. The use of lime juice and fresh vegetables has practically eradicated the disease.[b]

"Cholera was wont to visit the cities of the Atlantic coast in the past about every ten years, and it was a standing menace to the world every summer. It was not uncommon for the disease to decimate whole towns and cities. Since the discovery of its cause, however, it has been robbed of its terrors, and the children of to-day will probably never know of it except by name."

Malaria has been on the decrease ever since the discovery that the malarial organism is transported by a species of mosquito. Even the

[a] See Arthur Newsholme, "The phthisic death rate," Journal of Hygiene, July, 1906.

[b] Ditman, loc. cit., 14–15.

five years ending 1906 show a progressive decline in the death rate from malarial fever in the registration area. The figures are 5.4, 4.3, 4.2, 3.9, and 3.5 deaths per 100,000 of population, for the five years in question. In themselves, the figures are so small as to show the virtual disappearance of the disease, at least from the Northern States. It is still very common in the Southern States. Its evil is by no means to be measured by the deaths it causes. It produces chronic disability and predisposes to other diseases.[a]

Finally, the furnishing of pure milk to the infant population of the cities is eliminating year by year the infant scourges—diarrheal diseases and related maladies.

There are of course diseases which show no sign as yet of decreasing. The census volume, "Mortality Statistics of 1906" (p. 29) gives only one important disease (diabetes) as actually on the increase within the registration area, but several which are given as having "fluctuating rates," such as cancer, heart disease, and Bright's disease, seem still to have an upward trend.

It is known that malaria is preventable. Why, then, is it not prevented in the South? Probably for two reasons. First, the facts are not generally known, owing to lack of vital statistics in the Southern States. Second, owing largely to this ignorance no adequate effort has yet been made. As an example of what can be done we have the cleaning of Habana by Colonel Gorgas. The following table, supplied by him, shows the deaths from malaria from 1899 to 1907:

Year.	Number of deaths.	Year.	Number of deaths.
1899	909	1904	44
1900	325	1905	32
1901	151	1906	26
1902	77	1907	[a] 23
1903	51		

[a] Annual Report of the Sanitary Department for the City of Habana for the year 1907.

"The first year quoted, 1899, the malarial deaths were excessive, owing to the crowding into the city of the 'reconcentrados' and the starvation and misery thereby involved.

The next year, 1900, was about the normal rate. The next year, 1901, begins to show the effect of the antimalarial work done in connection with the yellow-fever work; 1901 was the first year of mosquito work in Habana. The last year, 1907, shows only 23 deaths from malaria. This means practically the extinction of malaria in Habana. The item of 23 deaths in 1907 from malaria would probably be covered by the malarial cases coming in from the rural districts and by mistakes in diagnosis."

The preventability of accidents is beginning to be appreciated. It is now proposed by Mr. W. H. Tolman to establish in New York a museum of safety and sanitation to demonstrate this fact. Mr. Frederick L. Hoffman, statistician of the Prudential Insurance Company, estimates the number of deaths among male workers alone in 1908 as between 30,000 and 35,000.[b]

[a] See "Report to the Conservation Commission" of L. O. Howard. "Economic loss to the people of the United States through insects that carry disease."

[b] "Industrial accidents," Bulletin of the Bureau of Labor, 1908.

Part II.—THE BREADTH OF LIFE VERSUS INVALIDITY.

Chapter III.—*Prevalence of serious illness.*

Section 1—*Loss of time.*

Length of life is but one indication of vitality. Everyone recognizes that the life of a valetudinarian or an invalid, however long, is but a narrow stream. We may therefore conceive, besides the dimension of length, another dimension of life which may be called its "breadth." By the breadth of life we mean its healthiness. Just as length of life is limited by and opposed to mortality or death, so breadth of life is limited by and opposed to invalidity or illness.

An ideally healthy life, free throughout from ailment and disability, is rarely if ever found. But it is the aim of hygiene to approximate such an ideal. Some persons imagine that length of life can be purchased only at the expense of breadth, and counsel the deliberate shortening of one's life for the sake of living it faster. In exceptional cases such a policy may be justified, but the study of longevity reveals the fact that, as a rule, length and breadth of life are not opposed, but that, on the contrary, the one can seldom be increased without an increase of the other. Centenarians are usually persons who have been exceptionally free from illness[a] and who have performed a large amount of work. This work is usually physical labor out of doors, although the few mental workers completing the century have also lived busy lives.

Chevreul, the distinguished French chemist who died twenty years ago at the age of 103, lived a life of great activity and usefulness as laboratory experimenter, as industrial chemist, as university professor, and as a writer and lecturer. It was said of Alexander Von Humboldt, who was 90 at the time of his death, that he had not only lived twice as long as others in years, but that in work accomplished he had lived twice as much per day, thus enjoying four times the average lifetime.

It is shortsighted to spend more vitality each day than we earn. Such a policy must not only prove suicidal sooner or later, but tends to narrow one's life in every way long before the arrival of death. The ordinary individual burns the candle at both ends. The result is an almost universal invalidism in some degree. While statistics are lacking, a wide observation seems to justify the conclusion that it is difficult to find a man or woman over 40 whose health has not become impaired in some manner. Few who have not studied the facts realize how common illness is, although we all know it is sufficiently common to make the question "How are you?" the ordinary form of salutation.

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[a] Metchnikoff, "The Prolongation of Life," English translation, New York, (Putnam's) 1908, p. 145.

Serious illness is such as totally incapacitates a person from work, whether or not he is confined to his bed. The burden of serious illness is felt in several distinct ways. There is the annual idleness entailed by this illness, the cost of maintaining institutions devoted to the care of the sick, and the cost to the individual of medicines, medical service, and nursing.

The amount of invalidity or illness in a community has been estimated by a number of different investigators, and in a number of different ways. While the results vary somewhat, on the whole they harmonize fairly well.[a]

The most careful consideration of the various illness statistics available was made by Farr. He finds that the rate of invalidity increases with age, and at the later ages increases with great rapidity. The material he has used has come chiefly from various friendly societies in Great Britain and Scotland, and especially from the East India Company. His final conclusion is probably nearly as valid to-day as then. It is that corresponding to each death in a community, there are a little more than two years of illness.

Another way of expressing the same fact is that for each annual death, there are on the average two persons constantly sick during the year. Applying this estimate to the United States,[b] in which about 1,500,000 persons die per annum, there are probably at all times about 3,000,000 persons seriously ill. This means an average of thirteen days per annum for each inhabitant.[c]

Returns gathered from 79 benefit societies in Scotland, aggregating over 100,000 members, and based on the experience of various periods between 1750 and 1821, showed that the average duration of sickness for each member under seventy years of age was ten days per year, 2 of which were assumed to be "bedfast" days, five as days of walking sickness, and three as days of permanent sickness.[d]

Section 2—*Particular diseases.*

It has been estimated that the number of persons in the United States constantly suffering from tuberculosis reaches 500,000. Of this number probably about half are totally incapacitated, while the remainder are able to earn about half of the ordinary wages.[e]

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[a] See Farr, Vital Statistics, London, 1885, pp. 501–514. Harald Westergaard, Mortalität und Morbilität, Jena, 1901, p. 683. See also a pamphlet by Hiram J. Messenger, actuary of the Travelers' Insurance Company, Hartford "The Rate of Sickness;" Pettenkofer, quoted by Uffelman, Handbuch der Hygiene, p. 3. Edwin Chadwick, "The Health of Nations," ed. by B. W. Richardson, 2 vols. (Longmans), London, 1887, Vol. I, p. 57; Mayo-Smith, "Statistics and Sociology," New York, (Macmillan) 1895, p. 158; "Statistische Jahrbuch für das Deutschen Reich, 1908," pp. 304–305.

[b] Judging from the experience of sickness insurance, there is more sickness in the United States than in England. See Dr. Edward Jarvis, "Political Economy of Health," Fifth Report of Mass. Board of Health, 1874. Dr. Jarvis also points out that estimates of illness are based on experience of provident persons among whom illness is a minimum, and that the estimates of illness take no account of chronic ailments or "decrepitude."

[c] Farr, Vital Statistics, p. 513.

[d] Edwin Chadwick, "The Health of Nations," vol. 1, pp. 56–57.

[e] Irving Fisher, "The Cost of Tuberculosis in the United States and Its Reduction," paper read before International Congress on Tuberculosis, Washington, 1908; see also Huber, "Consumption and Civilization," Philadelphia, 1906; and Bardswell, "The Consumptive Workingman," London, 1906.

For every death from typhoid fever, there are about 8 cases of illness, averaging seventy-five days of incapacity. But this is not the only loss. Professor Sedgwick has said, "Hazen's theorem asserts that for every death from typhoid fever avoided by the purification of a polluted public water supply two or three deaths are avoided from other causes. Working under my direction Mr. Scott MacNutt has recently been able to confirm this surprising theorem, and even to establish it as conservative. We have also gone further than Hazen and discovered what the other causes are from which deaths are thus avoided; and, although our results are not yet all published, I may say that conspicuous among these are pneumonia, pulmonary tuberculosis, bronchitis, and infant mortality." [a]

The prevalence of the hook-worm disease in the South has been a matter of investigation for several years by Doctor Stiles [b] of the Public Health and Marine-Hospital Service. The disease is remarkable not so much for its fatality, though that is large, as for the chronic incapacity for work which it produces. For this reason the hook worm has been nicknamed the "germ of laziness." The disease extends over the whole South, and is responsible for a large part both of the sickness (the so-called "laziness") and of the poverty of the "white trash."

There are no satisfactory statistics as to the extent of hook-worm disease; but it has been estimated that the sufferers are incapacitated for labor from one-fourth to one-half of their time. Most striking is the fact that the disease is easily preventable through the introduction of sanitary measures as well as curable by the proper (drug) treatment of the present victims. It has been largely eradicated from Porto Rico.[c] Hook-worm disease weakens when it does not kill and is known to be a precursor of tuberculosis.

Malaria is one of the diseases which are fatal relatively seldom, but which shorten life by predisposing to other causes of death, and narrow life by reducing working efficiency by a large percentage. Doctor Howard states that each year there are probably 3,000,000 cases of malaria in the United States, most of which are in the South. This is practically all preventable.[d]

Dr. Prince A. Morrow says that the number of syphilitics in the United States has been estimated at 2,000,000. This disease is not only in itself a danger, but it also causes a large number of diseases of the circulatory and nervous systems.

Doctor Morrow says that the extermination of social diseases would probably mean the elimination of at least one-half of our institutions for defectives. The loss of citizens to the State from the sterilizing influence of gonorrhea upon the productive energy of the family, and the blighting destructive effect of syphilis upon the offspring are enormous. In the opinion of very competent judges social

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[a] W. T. Sedgwick, "The Call to Public Health," Science, 1908, p. 198.

[b] Report upon the Prevalence and Geographic Distribution of Hook-worm Disease in the United States," Hygienic Laboratory, Bulletin No. 10, February, 1903, Washington.

[c] "Reports of Commission on the Suppression of Uncinariasis, 1904, 1905, 1906–7, 1907–8, San Juan, P. R." This commission has been succeeded by a bureau, the "Anemia dispensary service."

[d] See L. O. Howard, Report to Conservation Commission, "Economic loss to the people of the United States through insects that carry disease."

disease constitutes the most powerful of all factors in the degeneration and depopulation of the world.

Among the troops stationed in the Philippines, the venereal morbidity during the year 1904 was 297 per 1,000, largely exceeding the morbidity from malarial fevers and diarrhea; 22 out of every 1,000 soldiers were constantly ineffective from venereal diseases, four times as many as from any other disease.

The statistics of the Navy Department show during the same year that venereal disease was chargeable with a percentage of 25.2 of the total number of sick days in the hospital from all causes combined. In four years 949 men were discharged from the navy for disability from venereal disease. The statistics of the English army show that among the troops stationed in India 537 per 1,000 were admitted to the hospital for venereal disease. Of the troops returning home to England after completing their time of service in India, 25 per cent were found to be infected with syphilis.

No statistics exist for venereal disease in civil life. It may be more prevalent than in the army and navy service, since the inhibitory influence of military restraint and discipline do not exist and the opportunities for licentious relations are more abundant.

Neisser, a distinguished German authority, states that "fully 75 per cent of the adult male population contract gonorrhea and 15 per cent have syphilis."

What syphilis and gonorrhea represent in the lowered working efficiency of our population—to say nothing of the still more important subject of increased mortality—is impossible to estimate; but it would be difficult to overemphasize the grave danger to national efficiency from these and the other venereal diseases. And here again the most striking point is that the venereal diseases are preventable.

Alcoholism and drug addiction are maladies of frightful prevalence. They are so familiar as to be taken by many as a matter of course.

Venereal diseases and inebriety, whether alcoholic or drug, frequently lead to insanity. Statistics are not yet able to prove conclusively that insanity is increasing, though this is the opinion of the best judges.[a]

Dr. C. L. Dana, formerly president of the New York Academy of Medicine, believes the increase in insanity to be real as well as apparent. He says: "The annual increment of insane in Massachusetts, according to the Massachusetts board of lunacy, is 400 in about 10,000, or 4 per cent." At this ratio the annual increment for the United States would be approximately 5,600. "We may say that in the last twenty-five years the ratio of insane to sane has shown an apparent gradual increase from 1 to 450 to 1 to 300, and this latter seems to be about the ratio in those communities of North America and Europe in which modern conditions of civilization prevail. This average has varied but little in the last few years; the slight yearly increase probably will not change rapidly and probably not continue, for when the increase in the insane reaches a certain point of excess society will have to take notice of it and correct it."[b] There are no accurate fig-

[a] For a critical examination of statistical data on insanity, see Humphreys, (Noel, A.), "The alleged increase of insanity," Journal of the Royal Statistical Society, June, 1907.

[b] "Psychiatry in its Relation to Other Sciences," section on psychiatry at the International Congress of Arts and Sciences, St. Louis, September, 1904.

ures of the number of insane. Mr. Sanborn estimates that the number exceeds 250,000 in the United States.

Among defective and disabled classes are to be especially mentioned the feeble-minded, paralytic, crippled, blind, and deaf mutes. The aggregate disability of these groups is greater than is commonly recognized. The preventability is still less appreciated.

With reference to the losses each year from industrial accidents: The statistical report of the Interstate Commerce Commission for the year ending June 30, 1907, shows that during that year 11,800 persons were killed and 111,000 injured on our American railways, these figures including passengers, employees, and all other persons. A large number of the victims were railway employees, for whose safety Congress has passed a number of laws. The total number of cases of industrial accidents can not be estimated, owing to the lack of statistical information; but Census Bulletin 83 gives the number of deaths by accident and violence in 1900 at 57,500.

"Of 29,000,000 workers in the United States over 500,000 are yearly killed or crippled as a direct result of the occupations in which they are engaged—more than were slain and wounded throughout the whole Russo-Japanese war. More than one-half this tremendous sacrifice of life is needless." [a]

Mr. Frederick L. Hoffman estimates [b] that the number of accidents among men employed in the United States in 1906 was 208,000, of which about 5,000 were fatal. These figures are exclusive of mining, railway, and shipping accidents.

John Mitchell [c] estimates that for every 100,000 tons of coal produced in the United States one mine worker is killed and several injured. In 1907 the figures were 2,500 coal miners killed and 6,000 seriously injured.

In Wisconsin from October 1, 1906, to October 1, 1907, the total number of accidents reported which incapacitated the victim by at least two weeks was 13,572. The accidents to employees constituted 53 per cent of this number.[d]

Special trades have special perils for workmen. "Among diseases to which workmen are most often subject are the so-called 'inanition, scrofula, rachitis, pulmonary consumption, dropsy;' also rheumatic troubles, pleurisy, typhoid fever, gangrene, and the various skin diseases. Every epidemic, be it typhoid, smallpox, scarlet fever, dysentery, cholera, etc., draws its greatest army of victims from this class. For every death that occurs among the richer and higher classes there are many in the working class. It is the workman engaged in unhealthy factories first of all who fills the hospitals and their death chambers." [e]

It is the pollution of the air breathed by workmen, whether the pollution come through poisons or through dust, that makes many trades dangerous. Among poisonous trades are the many lead-using

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[a] Ditman, loc. cit., 43.

[b] In an article contributed to the "New Encyclopedia of Social Reform," 1908.

[c] Speech before the Governor's Conference on Conservation, White House, May, 1908.

[d] Thirteenth biennial Report, Bureau of Labor and Industrial Statistics, Madison, Wis., 1908.

[e] C. F. W. Doehring, "Factory Sanitation and Labor Protection," Bulletin Department of Labor No. 44, January, 1903, p. 2.

industries, foundries, and chemical factories. Investigations of the dust-producing trades have been made, showing the results on the respiratory systems.

Hirt's statistics show that men employed in dust-producing occupations suffer much more frequently from pneumonia and consumption than do those not exposed to dust. The relative frequency of these diseases per 100 workmen is as follows:

Cases of consumption and pneumonia per 100 workers in certain occupations.

	Consumption.	Pneumonia.
Workers in metallic dust	28	17.4
Workers in mineral dust	25.2	5.9
Workers in mixed dust	22.6	6.6
Workers in animal dust	20.8	7.7
Workers in vegetable dust	13.3	9.4
Workers in nondusty trades	11.1	[a] 4.6

[a] George M. Kober, M. D., "Industrial Hygiene," Bulletin of Bureau of Labor, March, 1908, p. 477.

Mr. Owen R. Lovejoy, secretary of the national child-labor committee, has condensed a table from Indiana reports [a] showing the high injury rate suffered by children in the industries.

Injuries to children in Indiana, 1907.

Proportion of adults injured	5 per 1,000 3 per 1,000
Proportion of children injured	20 per 1,000 10 per 1,000

The injury rate for children is shown to be three to four times as great as for adults.

CHAPTER IV.—*Prevalence of minor ailments.*

SECTION 1.—*Importance of minor ailments.*

The statistics of morbidity which we have given refer to forms which are relatively acute; but there are many milder forms which do not incapacitate the patient from work or compel him to take to his bed. The extent of these milder ills is not generally appreciated. They are often carefully guarded secrets. The individual often knows only his own physical troubles, but is unaware of the fact that almost every person about him has such troubles also. Once you penetrate beneath conventional acquaintance there will almost invariably be found some functional impairment of heart, liver, kidneys or bladder; or dyspepsia, gastritis, jaundice, gallstones, constipation, diarrhea; or insomnia, neurasthenia, nervousness, neuritis, neuralgia, sick headache; or tonsilitis, bronchitis, hay fever, catarrh, grip, colds, sore throat; or rupture, hernia, phlebitis, skin eruption; or rheumatism, lumbago, gout, obesity; or decayed teeth, baldness, deafness, eye ailment, spinal curvature, lameness, broken bones, dislocations, sprains, bruises, cuts, burns, or other "troubles."

[a] "Eleventh Annual Report of the Department of Inspection of Indiana, 1907," Exhibit C, pp. 166–198.

These so-called "minor ailments" will undoubtedly in the next few years receive much more attention than now. Until recently the physician has been accustomed to treat only acute diseases, but as preventive medicine gradually replaces curative medicine the physician will be more called upon to treat minor ailments. These are generally the first warnings of more serious troubles. If what seem to be "mere colds" were less commonly neglected, tuberculosis would more often be caught in its incipiency, and pneumonia and diphtheria would often be prevented.

From the "common colds" also tonsilitis and abscess of the ear can and do come, purulent inflammations of the pneumatic and venous cavities of the face and skull, and meningitis and cerebral abscess—all of which destroy many lives annually; or the lives may be saved by a surgical operation after a serious and prolonged illness. Tonsilitis, in turn, in addition to lighting up furious inflammations in its own immediate vicinity, can be held responsible in a certain number of cases for serious diseases at a distance from its own site. These are septic arthritis (inflammation of joints), septic peritonitis, appendicitis, endocarditis (valvular disease of the heart)—severe and frequently fatal diseases. Gastritis or gastroenteritis, sick headache, jaundice, lumbago, are not usually of serious import, but sometimes are the signs that point to an underlying cause (alcoholism, overeating, chronic protein intoxication, worry—business or domestic—sedentary life, etc.) which will lead later to arteriosclerosis, chronic nephritis, toxic amblyopia (optic nerve blindness), cirrhosis of the liver, cerebral hemorrhage or valvular disease of the heart.[a]

If the first twinges of rheumatic pains were heeded, gout and the dreaded arthritis deformans would lose most of their terrors. We could then arrest a great majority of serious affections at the very gateway. It can hardly be doubted that even such diseases as cancer, whose causation is not yet understood, gain a foothold through lowered vital resistance, manifesting itself at the first in minor ailments of some kind.

The American neurasthenia, widespread and subtle, has its grip on thousands of men and women, driving them from home and offices annually to sanitaria or various health resorts, and so breaking down their average vitality as to render them much more liable to serious sickness and death.

This, the most widely prevalent of all nervous disorders in this country, seems to be on the increase. It is very commonly found among persons who take no reasonable recreation—many business men, among others—and the loss of time and incapacitation for work are very great, often weeks and months at a time.

As to the extent to which minor ailments exist, no statistics are available. Doctor Castle, of Cincinnati, estimates, from an experience of many years in the medical supervision of institution employees and general practice, that there is an average of at least three days' time lost annually for each person in the population because of such minor ailments. Similarly, Dr. J. F. Morse, of the Battle Creek Sanitarium, who has had a long experience in dealing with a large number of cases, estimates that the average "well man" loses on an average five days a year from work on account of headaches, toothaches, "colds," and similar minor ailments which do not come under the head of any of the diseases reported.

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[a] Letter from Dr. Chas. H. Castle.

Section 2.—*Preventability of minor ailments.*

That almost all minor ailments can be avoided is scarcely to b doubted. Doctor Gulick is "inclined to believe that something lik nine-tenths of all the minor ailments that we have, and which consti tute the chief source of decreasing our daily efficiency, could b removed by careful attention." "With the removal of nine-tenths o our disabilities and the conservation and further development of ou natural powers," he adds, "the average person can increase his effi ciency 100 per cent, that is, he can be twice as effective. This doe not refer to doing merely or mainly twice as much work, of course but by making less mistakes, and by working at a higher degree o speed when he does work. By working under conditions so that th work does not need to be repeated, the whole total will be much greater—I think not too much to say twice as great—as under ordi nary conditions."

Minor ailments are preventable by leading a reasonably hygienic life and by revising the modern gospel of "hustle"—which latter usually means crude, imperfect, and slovenly work, whether mental or manual. The prevention of these diseases would "cost" nothing—for it costs nothing to stay well.

If, again, we consider the experience of those who have made a serious attempt to avoid minor ailments, their preventability becomes clear. Personally, I have known of scores of cases in which the tendency to catch cold has been almost completely overcome. In one case a physician, who as a boy had suffered from continual colds and hay fever, succeeded, through the simplification and control of his diet, in attaining almost complete emancipation, which has lasted over forty years. Another physician reports that for ten years, during which time he has taken special means to produce complete evacuation, he has not caught a single cold. A large number of cases observed are of persons, physicians as well as laymen, who have taken the outdoor cure for tuberculosis or nervous prostration. These persons not only succeeded in combating these serious troubles, but in completely freeing themselves from liability to colds. Evidently, if the outdoor life had been adopted simply as a preventive of colds, it would have prevented originally, as it cured subsequently, their more serious disorders.

Chapter V.—*Prevalence of undue fatigue.*

Section 1.—*Strength, endurance, and fatigue.*

When a person is free from all specific ailments, both serious and minor, he usually calls himself "well." There is, however, a vast difference between such a "well" man and one in ideally robust health. The difference is one of endurance or susceptibility to fatigue. Many "well" men can not run a block for a street car or climb more than one flight of stairs without feeling completely tired out, while another "well" man will run 25 miles or climb the Matterhorn from pure love of sport. The Swiss guides, throughout the summer season day after day, spend their entire time in climbing. A Chinese cooly will run for hours at a stretch. That the world regards such performances as "marvelous feats of endurance" only

shows how marvelously out of training the world as a whole really is. In mental work some persons are unable to apply themselves more than an hour at a time, while others, like Humboldt or Mommsen, can work almost continuously through fifteen hours of the day.

As Mosso[a] and others have proved, muscular fatigue is a chemical effect, due to the circulation of "fatigue poisons" in the blood. This has been strikingly shown by experiments by Weishardt and others on dogs; when blood is transfused from an exhausted dog to a "frisky" one, the latter immediately wilts and becomes fatigued like the former, although he has not exerted himself in the least. In order to reduce fatigue, therefore, we should keep down fatigue poisons. It is not unlikely that almost all poisons produce fatigue, whether the poisons come from infections, from drugs, from impure or excessive food, from bad air, or from exertion.

It should be noted that endurance is a quality quite distinct from strength.[b] Strength is measured by the utmost force a muscle can exert once; endurance by the number of times it can repeat an exertion requiring a specified fraction of available strength at the start. Thus, if each one of two men is barely able to lift a dumb-bell weighing 100 pounds, their strengths are equal, but if one of them can raise a dumb-bell weighing 50 pounds 20 times, while the other can raise it 40 times, the latter may be said to have double the endurance of the former. Another mode of expressing the same thought is that endurance is measured by the slowness with which strength decreases through exertion.

Section 2.—*Alcohol and fatigue.*

Of all poisons in ordinary use, alcohol and tobacco are the most common. That alcohol increases fatigue is now commonly recognized by athletes. "Alcohol gives no persistent increase of muscular power. It is well understood by all who control large bodies of men engaged in physical labor that alcohol and effective work are incompatible."[c]

One of the most interesting features of the cycling sport, when long hours were the fashion a few years ago, was the fact that the wayside seller of drinks found himself forced to supply chiefly "temperance drinks." The cyclists discovered that they could not make their "century runs" on alcoholic beverages. Two friends report that they stopped for refreshments and drank beer. Resuming their ride they found it hard to propel the machine, and both imagined some obstruction had lodged in the gears. Only after having dismounted and satisfied themselves to the contrary did they come to the conclusion, whether rightly or wrongly, that the resistance was in their own legs and was due to the beer.

Careful experiments with alcohol in relation to fatigue have been reported by Rivers,[d] who shows that alcohol diminishes the capacity

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[a] See Fatigue, English translation. New York (Putnam), 1904.

[b] See Irving Fisher: The Effect of Diet on Endurance. (Publications of Yale University, Transactions of the Connecticut Academy of Arts and Sciences; New Haven, 1906, p. 1.)

[c] The Liquor Problem, a summary. Report of subcommittee of committee of fifty on physiological aspects of the liquor problem. New York (Houghton-Mifflin), 1905.

[d] W. H. R. Rivers: "Influence of Alcohol on Fatigue, etc." London (Edward Arnold), 1908, pp. 89–90.

for exertion. Experiments carried on by Professor Aschaffenburg with four typesetters, all users of alcohol, showed that on days when Greek wine, containing 18 per cent of alcohol, was given the men there was considerable diminution of the capacity for work. On the alcohol days two of the men did decidedly less work, while the work of the remaining two was marked by great irregularity.

The injury from alcohol is mitigated, but not excluded, through combination with sugar, malt, and other beneficial ingredients, as in beer.

Section 3.—*Tobacco and fatigue.*

As to tobacco it is a common observation that smoking interferes with one's "wind" in running. The poisons which probably bring about this result include others than nicotine. Possibly the most important poison is carbon monoxide, which has a great affinity for the iron in the blood.[a] When the smoker "inhales," this poison, probably joined with others, enters directly into the blood stream.

In an experiment carried on by Doctor Lombard, "smoking was found to have a very depressing effect upon the strength of the voluntary muscular contractions. * * * Undoubtedly the effect of tobacco to lessen the voluntary power is due to its influence upon the central nervous system."[b]

It is the testimony of many users of tobacco that the habit of smoking leads to nervousness and disinclination to exertion directly after smoking.

Experimentation has shown that smoking increases blood pressure. The greater resistance to circulation offered by the blood is presumably due to the excitation caused by the introduction into the blood stream of foreign matter from the tobacco. There is reason to believe, though the fact has not been established, that endurance is lessened by high blood pressure.

Section 4.—*Diet and fatigue.*

Poisons may also enter the system through food. Many poisons come from diseased, contaminated, or adulterated foods; but they may also be due to excess of food or wrong preparation of foods, and especially to the decomposition of protein (the principal ingredient of white of egg and lean meat) in the colon. The absorption of such poisons causes auto-intoxication.

It has long been known by physiologists that the putrefaction in the intestines is the putrefaction of protein. But only recently have they raised the question whether a reduction of the protein element of food would be feasible and whether the resulting reduction in putrefaction and auto-intoxication might not be advantageous.[c] These questions are still under debate, but the trend of physiological opinion is increasingly in favor of protein reduction. Practically this means a lessening of the consumption of lean meat and eggs.

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[a] "The toxicity of tobacco smoke," The Lancet, CLXXV, 1908, p. 104.

[b] Warren P. Lombard, M. D., "Some of the influences which affect the power of voluntary muscular contraction." Journal of Physiology, Vol. XIII, 1892, p. 48.

[c] See C. A. Herter, "Bacterial Infections of the Digestive Tract," New York (Macmillan), 1907.

Evidence has accumulated, though it has not yet been put in proper experimental form for absolute proof, that auto-intoxication is not only an exceedingly common affection, but also the chief cause of undue fatigue. Most persons know the heavy feeling and disinclination to exertion which generally accompany constipation, and, on the other hand, the relief which comes with a complete evacuation.

Leaving auto-intoxication aside, Professor Chittenden is of the opinion that waste products from combustion of protein are probably responsible for fatigue. Whatever the explanation, Professor Chittenden found in his classical experiment[a] with a squad of soldiers, that strength and endurance were increased by a reduction of the protein. Thirteen soldiers were placed for six months on a diet containing a much smaller quantity of protein food than what is prescribed by ordinary dietary standards and containing only one-third of what is demanded by common American usage. Professor Chittenden's results are gaining recognition, but they will need to be further tested before any unanimity of opinion can be reached.

Analysis of the diet of several hundred vegetarians shows that on the whole they are lower in protein than the average American. Comparative experiments on 17 vegetarians and 25 meat eaters in the laboratory of the University of Brussels have shown little differences in strength between the two classes, but a marked superiority of the vegetarians in point of endurance. The average superiority was 53 per cent. The vegetarians recuperated from fatigue more quickly than the meat eaters.[b] To what extent, if at all, the superiority of the vegetarians was due to vegetarianism as such, and to what extent to the fact that they made a more moderate use of protein, can not be exactly determined, although the evidence indicates that the lower protein is the essential factor. The virtues and drawbacks of vegetarianism as such have as yet received almost no scientific study.[c] Professor Chittenden is now engaged in such a study.

In another experiment, comprising 49 subjects and contrasting those on high and low protein diets, it was found that the low protein subjects had greater endurance.[d] For instance, the test of "deep-knee bending" showed that whereas the high-protein subjects could seldom exceed 400 or 500 times, the low-protein men could frequently exceed 1,000, and in one case reached 2,400.

The writer has in his possession several hundred unpublished individual records of men on a low and high protein diet. These, on the whole, seem to show a considerable superiority in endurance among those using the lesser amounts of protein. But while the trend of evidence seems at present to favor a reduction in protein, the question is not yet settled.[e] There exist many conspicuous cases of high

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[a] See Russell H. Chittenden, "Physiological Economy in Nutrition," New York (Stokes), 1904, and "The Nutrition of Man," New York (Stokes), 1907.

[b] "Enquete Scientifique sur les Vegeteriens de Bruxelles," par Mlle. le Dr. J. Ioteyko and Mlle. Varia Kipiani, Bruxelles (Lemartin), 1907. For English abstract see "Diet and Endurance at Brussels," Science, Vol. XXVI, 1907, pp. 561–563.

[c] An exception is Caspari, "Physiologische Studien über Vegetarismus," Bonn (Hager), 1905; see also Gautier, "Diet and Dietetics," English translation, London, 1906.

[d] Irving Fisher, "Influence of flesh eating on endurance," Yale Medical Journal, March, 1907.

[e] See, for example, Prof. F. G. Benedict's paper on "The nutritive requirements of the body," American Journal of Physiology, Vol. XVI, 1906, pp. 409–437.

protein and great endurance. A striking instance is that of the pedestrian Weston.

In an experiment on nine healthy students, the writer found that thorough mastication seemed to cause a gradual decrease in protein. The significance of the experiment lay in the improvement in physical endurance of eight of the men, which increased over 90 per cent in five months. The ninth man—the only one whose protein was not greatly reduced—failed to improve in endurance.[a]

Section 5.—*Exertion and fatigue.*

Exertion increases combustion of oxygen, and the capacity for exertion is intimately related to the completeness of this combustion.

Experiments in artificially administering oxygen to athletes have been made in England by Hill, Flack, Pombrey, and others.[b] Following these, a series of experiments in swimming recently took place at Huntington, L. I. The swimmers to whom oxygen had been administered surpassed their nonoxygenized competitors as well as their own previous natural records. Doctor Bising, who carried on the experiment, states that the effects of oxygen inhalation are useful for short efforts only. At most the oxygen exercises its influence for not more than three minutes.

Perhaps the most important of the common influences affecting the capacity to resist fatigue is physical exertion. It is well known that a man "in training" has greater endurance than one who attempts exertion without previous systematic exercise or training. In general, it may be said that a person in the "pink of condition" is fit not only for physical but also for mental exertion. The great majority of adults are far from being "in condition," suffering either from lack of exercise or from too much exercise. The ordinary man errs either in one direction or the other. The brain worker lives too sedentary a life, while the manual worker, through fatigue caused by long hours, is in a continual state of overexertion. Could these conditions be remedied, endurance, as measured by capacity to withstand prolonged strains, might be greatly increased.

Experiments have shown that physical endurance can be doubled by dietetic causes alone, or doubled by exercise alone. By both together it is not unlikely that it could be tripled or quadrupled. But when it is said that the endurance, or capacity for exertion, of the ordinary healthy man could be thus multiplied, it is not meant that the hours of his daily work, or even his daily output of work, could be increased in such a ratio. What it does mean is the removal of the fatigue limit, a freer and more buoyant life, and a visible increase in the quantity and quality of work per hour.

In an ideal life fatigue would seldom be experienced. But in most lives, unfortunately, fatigue is a daily experience. A workman who gives intelligent and systematic care to the body writes that when after a long day's work the factory whistle blows at night he, unlike his fellows, feels as fresh as when he began work in the morning. Workmen can by such self-care mitigate some of the evils of

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[a] Irving Fisher, "Effects of diet on endurance," loc. cit.

[b] British Medical Journal, 1908, August 22, p. 499; also August 29, p. 578, Journal of Physiology, 1908, XXXVII, 77–112.

"the long day." But they are amply justified, both in the interest of their own and of national efficiency, in continuing their efforts toward a shortening of the work day.

SECTION 6.—*The working day.*

The present working day is a striking example of the failure to conserve national vitality. In order to keep labor power unimpaired, the working day should be physiological—i. e., it should be such as would enable the average individual to completely recuperate over night. Otherwise, instead of a simple daily cycle, there is a progressive deterioration. A reduction in the length of the work day would be a chief means of improving the vitality of workmen, as well as the worth of life to them.

The fatigue of workmen is largely traceable to their long work day and serves to start a vicious circle. Fatigue puts the workman in an abnormal frame of mind. He seeks to deaden his fatigue by alcohol, tobacco, exciting amusements, and excesses of various kinds. The momentary relief which he thereby obtains is purchased at the expense of an increasing susceptibility to fatigue, resulting sooner or later in complete depletion of his vital energies and in the contraction of tuberculosis or other fatal disease. The decrease in the length of the working day has not diminished the total output.

An instance in which the eight-hour day superseded the nine-hour day with entire success is the case of the Salford Iron Works, of Mather & Platt, at Manchester, England, which changed to the eight-hour day in 1893. As the firm's products were subject to keen competition in both home and foreign markets, it was obliged to look carefully after the labor cost, and its conclusion that such cost did not increase in consequence of the reduction in working hours was reached after extremely accurate comparisons by accountants, who of course took into consideration the saving in consumables, wear and tear, fuel, etc. The Bureau of Labor inquired of Messrs. Mather & Platt if they were still on the eight-hour basis, and received a reply dated May, 24, 1904, in which they stated that—

> our experience since the first year in which it (the eight-hour system) was tried has fully borne out the conclusions then arrived at, and we are fully satisfied that as regards the comparison between eight and nine hours per day the balance of advantages is in favor of the shorter period.[a]

In 1894 the hours of labor of about 43,000 workmen in British government factories and workshops were reduced to forty-eight per week. Of this number, 18,600 received a reduction of five and three-fourths hours a week, and 24,300 had their time reduced two and one-half hours a week. With no change in piece rates the workmen were able to earn as much as formerly. Day workers received an increased hourly rate of pay to make their earnings per week of forty-eight hours equal to those per week of fifty-four hours. It was not found necessary to increase the number of day workers.[b]

In 1899 the owners of the great Zeiss optical goods factory at Jena, Germany, introduced the eight-hour day and then made careful records of the results. In 1903 it was announced that although the aggregate number of hours worked had decreased 15 per cent the output per hour had increased 16.2 per cent.[c]

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[a] New York Labor Bulletin No. 25, June, 1905, p. 240.

[b] Board of Trade Labor Gazette, July, 1905, reported in New York Labor Bulletin No. 28, March, 1906.

[c] New York Labor Bulletin, No. 25, June, 1905, p. 240.

At Liege it was found in a sulphuric acid establishment similar to a foundry [a] that shortening the working day from eleven hours to ten, from ten to nine, and so on gradually down to seven and one-half, resulted, in each case, in an increase of the output.

The Solvay Process Company, of Syracuse, installed in 1892 a system of three eight-hour shifts in place of the two previous shifts of eleven and thirteen hours, respectively. It was stated by the assistant general manager in 1905 that the change had considerably lessened the wear and tear on the men, and that they could be called on to do their work at their highest state of efficiency, which had not been possible on the two-shift basis. President Hazard of the company writes:

> In general, I can say that the results of the change from a twelve-hour shift to an eight-hour shift were very satisfactory and have continued to be so. While the immediate result was to considerably increase the cost per unit of product, the efficiency of the men gradually increased, so that at the end of about one year the first increase has been overcome and the cost per unit of product fell to a point even lower than had been obtained under the twelve-hour shift, and further the time consumed per unit of product has since been so reduced that we are today and for some time have been operating with a smaller number of hours per unit of product than we had under the twelve-hour shift.

Further proof of the benefits of the change to the three-shift day is furnished by the records of the Solvay Mutual Benefit Association for 1891 and 1904. The days lost per man by sickness each year fell from seven and one-half days in 1891 to five and one-half days in 1904.

It is not maintained that in all cases productivity will be as great in eight hours as in nine. Cases to the contrary could also be cited. The point to be insisted upon is not that it is profitable to an employer to make the work day shorter, for often it is not, but to show that it is profitable to the nation and the race. Continual fatigue is inimical to national vitality, and however it may affect the commercial profits of the individual it will in the end deplete the vital resources on which national efficiency depends.

In the interests of this efficiency, a longer time at noon for lunch is usually necessary. The present economy of lunch time is short-sighted, tends to food bolting, indigestion, a drowsy and tired afternoon, and inferior work. This has been shown by actual experience.[b]

The accident bulletins of the Interstate Commerce Commission contain frequent records of disasters caused by the long hours of railway employees. In a recent bulletin, No. 27, two collisions are attributed to the mistakes of employees who have been on duty much longer than the instinct of safety should allow. Collision No. 3,[c] which killed 2 and injured 13, was due to the mistake of a station operator who had been on duty from 7 a. m. to 3.30 p. m. and who had returned to duty at 8 p. m. The collision took place at 12.30 a. m. the next morning.

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[a] See L. G. Fromout, "Une Experience Industrielle de Reduction de la Journel de Travail," Brussels, Solvay Institute, 1906.

[b] See especially description of a French experiment cited by Hubert Higgins in Humaniculture, New York (Stokes), 1906.

[c] Accident Bulletin No. 27, January to March, 1908.

SECTION 7.—*Importance of preventing undue fatigue.*

The economic waste from undue fatigue is probably much greater than the waste from serious illness. We have seen that the average serious illness per capita is usually about two weeks each year. This is about 4 per cent of the year. Expressed differently, about 4 per cent of the population is constantly sick.

On the other hand, the number that suffer partial disability through undue fatigue certainly constitute the great majority of the population. No observer can fail to conclude that this is true of the American working, business, and professional classes, and the latest word among the students of school hygiene is that it is true to a large extent even among children. If therefore we assume that only 50 per cent of the population is suffering some impairment of its best powers through undue fatigue, we are on safe ground. The extent to which the power of this supposed 50 per cent of the population is impaired must certainly exceed 10 per cent. When we consider that young men, supposed to be perfectly well, have the enormous room for improvement indicated in this chapter, and when we consider the gratifying results of experiments with a shorter work day it will be seen that the true impairment is probably several times 10 per cent. Yet if only 50 per cent of the population are suffering an impairment equal to only 10 per cent of its working powers, the result is equivalent to 5 per cent of the population suffering total impairment which is more than the 4 per cent impairment from serious illness.

The relatively slight impairment of efficiency due to overfatigue leads to more serious impairment. Just as minor ailments prove to have an unsuspected importance when considered as gateways to serious illness, so the inefficiency from fatigue is vested with great significance as the first step toward minor ailments. Obviously if overfatigue could be reduced to a minimum, this reduction would carry with it the prevention of the major part of minor ailments, which in turn would lead to a great reduction in more serious illness, and this finally would lead to a great reduction in mortality. A typical succession of events is first fatigue, then colds, then tuberculosis, then death. Prevention, to be effective, must begin at the beginning.

But prevention is merely the first step in increasing the breadth of life. Life is to be broadened not only negatively by diminishing those disabilities which now narrow it, but also positively by increasing the cultivation of vitality. Here we leave the realm of medicine and enter the realm of physical training. The first and lowest step is gymnastics. This is valuable—far more so than the ordinary sedentary man who neglects it realizes—but it is after all a kind of medicine not altogether pleasant to take and far less valuable to him who takes it than are athletic sports, which constitute the next highest stage. Beyond athletic sports in turn comes mental, moral, and spiritual culture, the highest product of health cultivation. It is an encouraging sign of the times that the ecclesiastical view of the Middle Ages, which associated saintliness with sickliness, has given way to modern "muscular Christianity," typified in Young Men's Christian Associations with their gymnastics and athletics. This is but one evidence

of the tendency toward the "religion of healthymindedness" described by Professor James. Epictetus taught that no one could be the highest type of philosopher unless in exuberant health. Expressions of Emerson's and Walt Whitman's show how much their spiritual exaltation was bound up with health ideals. "Give me health and a day," said Emerson, "and I will make the pomp of emperors ridiculous." It is only when these health ideals take a deep hold that a nation can achieve its highest state of development. Any country which adopts such ideals as an integral part of its practical life philosophy may be expected to reach or even excel the development of the health-loving Greeks.

The means of securing both the negative prevention of invalidity and the positive accumulation of vitality will form the subject of Part III.

Part III.—METHODS OF CONSERVING LIFE.

Chapter VI.—*Conservation through heredity.*

Section 1.—*Heredity and environment.*

That the waste of life through preventable disease and death is enormous appears clearly from the facts already cited. The practical problem is this: If such waste is really preventable, what are the conditions necessary to make prevention an accomplished fact? There are two main conditions. First, a general desire for improvement; second, a general knowledge of how to secure that improvement.

Once the general public recognizes the needless waste of vitality, it will not be content until that waste has been eliminated. To such an awakening the American instinct of economy is in itself a powerful spur. Practical men are coming to consider it "good business" to take some care of their own vital resources. As this view gains ground, habits and fashions will adapt themselves to the change. The folly of the man who loses his health in the pursuit of wealth, and then for the rest of his days spends his wealth to win back health, is beginning to be appreciated.

Human vitality depends upon two primary conditions, heredity and hygiene, or conditions preceding birth and conditions during life. In other words, vitality is partly inherited and partly acquired.

It is well known that cultivated plants and animals have been greatly changed and developed by breeding. "The original apple, as offered by nature to mankind, was the small, sour, bitter crab of the forest, unpleasant, indigestible, innutritious. * * * In 1710 Doctor Davenant, a writer on political economy, estimated that the average weight of dressed cattle did not exceed 370 pounds. * * * In 1846 McCullock stated that 'at present the average weight of cattle is estimated at or about 800 pounds.'"[a]

Human heredity is now dependent on haphazard selection. Little attention is paid by those who contemplate marriage to the question of how much stamina will be transmitted to the next generation. The story was told of a famous dog fancier who, when asked why he paid so much attention to his dogs but delegated the care of his children to nurses, replied: "My dogs have a pedigree." Human pedigrees, no less than canine, rest on a physical basis; yet genealogical records of human beings, while they have much to say of social position, have very little to say of physical capacity or intellectual ability. Those who, like Galton and Pearson, believe in a science of eugenics, hope that the day will come when pride of inheritance will include as im-

[a] See Dr. Edward Jarvis, Political Economy and Health, Fifth Report, Mass. Board of Health, 1874. Doctor Jarvis adds that human life is as "expansible" as animal life.

portant, if not as the chief items, physical, mental, and moral stamina. A tendency in this direction can be discerned. When the nobility commanded the reverence of all classes, quite irrespective of ability, commoners, however well endowed by nature, could never obtain the same respect. But to-day the English House of Commons is more honored and respected than the House of Lords.

Once the importance of a physical pedigree comes to be rated at its true value, a man's pride in his own inheritance will show itself in a correlative feeling of responsibility for future generations. For the sake of children yet unborn, men and women will set for themselves physical ideals of the highest order.

SECTION 2.—*Eugenics.*

The whole question of race improvement through heredity constitutes the subject-matter of the new science of eugenics. The devotees of this science are at present engaged in studying the laws of heredity in all its aspects. The Mendelian doctrine of heredity, with the theories of Darwin and Weissmann, are some of the topics which need to be studied in reference to their practical application.

Until more results have been obtained, it would be premature to make great claims for the possible future usefulness of applied eugenics. A word may be said to prevent misunderstanding as to its aims. Many have supposed that the object of eugenics was to bring about suitable marriages by compulsion of the Government. Such a proposal would not only be absolutely impracticable, but would defeat the very ends aimed at. Marriage, above all human choices must, as a rule, be left to the individual, guided by his ideals alone. By the change of these ideals alone can the character of marriages be influenced. Sir Francis Galton, the founder of the science of eugenics, expects intelligent public opinion to be the chief guide in marriage. Just as the union of brother and sister is tabooed, and the marriage of even first cousins[a] is eyed askance—whether justly or not does not matter—so, if the aims of eugenists are carried out, an obviously unhygienic marriage will be frowned upon. It was somewhat in this way that the ancient Sparta raised its vitality to a high point of physical excellence.

Galton has pointed out[b] that present restrictive rules of marriage selection are endured without any sense of loss of privilege or freedom. For example, members of the European nobility are, in their marriage choice, restricted almost wholly to fellow-aristocrats; yet so much has this restriction become a part of their ideal and creed that the narrowness of the range of choice is not usually realized.

Even granting that some marriages are studiously calculated to win money or title, a much stronger or more pervasive, although unconscious, influence is exerted by the ideals which young men and women at marriageable age have formed of what their companions for life should be. Nothing is more certain than that if from

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[a] In at least 20 States the marriage of first cousins is forbidden by law. An excellent discussion of this subject is contained in "Consanguineous Marriages in the American Population," by G. B. L. Arner, Ph. D., New York (Longmans), 1908.

[b] "Sociological Papers," London (Macmillan), 1906, Vol. II, p. 12.

childhood they were trained to regard vitality as the first essential in an ideal man or woman, this would influence their personal fancy. Health, beauty, and vitality are natural objects of admiration and love. Titles, wealth, and other extraneous attractions are not. To lessen the public esteem for these, and to increase the esteem for natural human merit, will tend to increase not only the number of healthy marriages, but the importance of the rôle played by normal love. If, therefore, eugenic ideals ever hold sway, love marriages will not only continue to exist, but will become more frequent. Love is a primal and natural instinct, and the more natural men and women are, and the more highly they esteem natural vitality, the more will they be guided by mutual attraction.

If a considerable percentage of the population once shall come to regard vitality as an essential endowment, the effect on mating will be felt in two ways: First, a larger percentage of healthy persons will marry, leaving a larger percentage of unhealthy persons single; second, healthy persons will mate with each other, and unhealthy persons, in so far as they marry at all, will do so among themselves. Of mixed matings there will be a smaller number. Both of these results will tend gradually toward the improvement of the race. That the first—the increased proportion of marriages among the healthy—will do so, is obvious. The second—the marriage of like with like in respect to health—would, it seems probable, operate to increase the number of progeny of healthy couples and decrease that of the unhealthy, especially after the first generation.

Since athletics have come into vogue it is well known that the athletic ideal has led to athletic mating. The tendency of the present devotion to athletics must be to elevate the respect for physical prowess. The high esteem entertained in Japan for physical training and for hygiene as a guarantee of the fighting power of the country, constitutes an object lesson, if not a warning, to Americans who wish their country to be the peer of the best. It would be folly, of course, to expect any change in ideals so complete that there would not be numerous exceptions to hygienic mating, but, once the bulk of mankind are guided by a truer principle in forming marriages, the effect on racial development will make itself distinctly felt within a generation. As President Roosevelt has said: "The preservation of national vigor should be a matter of patriotism." Some persons would even make it a matter of religion.

Section 8.—*Eugenics and law.*

It is possible, however, that governmental interference with the birth rate may in future be employed to a limited extent. Two ways have been suggested: One is for the Government to give prizes or bounties to couples that conform to certain specified standards in the same way as the French Government has encouraged the increase of population by offering inducements to couples of the poorer class who raise seven or more children.[a]

The second is to forbid alliances among criminals, paupers, and the feeble-minded. These classes fall under the tutelage of the State,

[a] In 1889, fathers of seven children were made exempt from payment of the personal property tax. This exemption was in 1890 limited to fathers who paid taxes of not over 10 francs each.

and thereby forfeit their right to free choice. Already Indiana,[a] Connecticut,[b] Michigan,[c] and other States in this country, have passed laws of this sort.

Indiana extends the prohibition to all persons suffering from transmissible disease of any sort. This prohibition is called into daily operation in that State. It is in the power of the Indiana state board of health to raise by degrees the standards of health demanded of those who desire license to marry, a provision that aims directly at the improvement of human vitality in the State. Indiana has gone even further and has recently provided[d] that confirmed criminals, imbeciles, idiots, and rapists, procreation by whom is deemed inadvisable by experts, shall be unsexed (or "sterilized") by surgical operation. Under this law over 800 prisoners have been sterilized to date.[e]

The experiments started in Indiana and other States will be interesting to watch, and promise an improvement over the conditions which have prevailed too often in the past. Professor Brewer, of Yale, tells of a case in Connecticut some years ago where a feeble-minded pauper woman, kept as a public ward, was admired by a half-witted farmer living in an adjoining town. A selectman of the town maintaining the woman "to get rid of her support" encouraged their marriage. His short-sightedness, even from the standpoint of immediate money economy, to say nothing of racial economy, became apparent when, a few years later, she and her husband and three idiotic children drifted into the poorhouse of the husband's town.

That laws like the ones discussed, but of gradually increasing severity, will become common in the future seems likely; and, as Professor Lankester has remarked, humanity will probably submit in the future to communal restriction of the right to multiply with as good grace as it has given up the right to rob and to rape.[f]

The effect of restrictions upon free right of marriage is discussed by Doctor Hurty, secretary of the Indiana state board of health, as follows:

> It seems most essential and necessary that we have laws for the prevention of the production of the unfit if society is to be saved from destruction. Modern hygiene, under which I include in this instance all such benevolent institutions as insane asylums and institutions for the feeble-minded, is extending the duration of life of the dependents and deficients, and it might be added that the humane and hygienic care in the prisons is extending the duration of life of the delinquents. In Indiana the life duration of the insane has been extended eight years within the last two decades. This slight extension means a very considerable burden upon the people, and if this class of deficients is unrestricted we can readily see what a burden time will place upon society. The production of the unfit must cease if charity and hygiene continue. Otherwise it seems certain that society will be swamped.

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[a] Indiana Laws of 1905, chap. 126, H. 118, sec. 3.

[b] Connecticut Statutes (revision of 1902, sec. 1354), forbid the marriage of epileptics.

[c] Michigan forbids the marriage of epileptics.

[d] Indiana Law of 1907, chap. 215, H. 364.

[e] Letter from Dr. J. N. Hurty.

[f] E. R. Lankester, "The Kingdom of Man," London (Constable), 1907, p. 41. The recent report of the Royal Commission on the Care and Control of the Feeble Minded recommends such restriction.

While institutional treatment of the insane is right and proper rom a humanitarian point of view, by bringing an increase in the verage insane lifetime it adds to the public burden and enlarges the gures of the living insane. Mr. Sanborn estimates the average nsane life in Massachusetts at thirteen years, of which at least three ears occur, on the average, before hospital treatment is applied. Ie adds:

I suspect we have come nearer to statistical accuracy on this question in Iassachusetts than has been reached in any region of equal population anyhere. The world has been gradually coming round to the conclusions reached y the late Dr. Pliny Earle (of Northampton) and myself, viz, that the changes i the social and sanitary conditions of all civilized countries have increased ie number (proportioned to population) of new cases of insanity, while the nproved treatment of patients in the meantime has made the average insane fe longer than formerly, and that in spite of the well-known increase in forms, ke paresis and epilepsy, which may soon end fatally.

Interesting records exist of two families of criminals, the so-called Jukes" and the "Tribe of Ishmael." From the one man who ounded the "Juke" family came 1,200 descendants in seventy-five ears; out of these, 310 were professional paupers, who spent an ggregate of two thousand three hundred years in poorhouses, 50 ere prostitutes, 7 murderers, 60 habitual thieves, and 130 common riminals.

Dugdale[a] has estimated that the "Juke" family was an economic oss to the State, measured in terms of potential usefulness wasted, osts of prosecution, expenses of maintenance in jail, hospital, and sylums, and of private loss through thefts and robberies of $1,300,000 i seventy-five years, or over $1,000 for each member of the family.

Similarly, the "Tribe of Ishmael," numbering 1,692 individuals in ix generations, has produced 121 known prostitutes and has bred undreds of petty thieves, vagrants, and murderers. The history of ie tribe is a swiftly moving picture of social degeneration and gross arasitism, extending from its seventeenth-century convict ancestry o the present-day horde of wandering and criminal descendants.[b]

Had the original criminals in the "Juke" family and the "Tribe f Ishmael" been sterilized under some law like that of Indiana, this ountry would not only have been spared a widely disseminated riminal, epileptic, and immoral strain, but would have saved hunreds of thousands of dollars paid out for criminal suits and for istitutional care, to say nothing of the expenses still to come from ie incapacity and criminality of future generations.

These cases present only one side of the case. Over against them iay be set illustrious families in which great intellectual ability and ioral worth have been passed on through many generations. Such a ne is the Hohenzollern family. In commenting on the frequent ocirrence of persons of surpassing mental and moral attainments in iis family, Woods[c] says: "It is particularly suggestive of what might e done with the human race were mankind ever so inclined." A simiir example from a different walk in life is afforded by the Darwin imily, where for four generations in direct line (Erasmus, Charles,

[a] R. L. Dugdale: "The Jukes," New York (Putnam), 1877.
[b] Oscar C. McCulloch, "The Tribe of Ishmael," a study in social degeneration, Report of Fifteenth Annual Conference of Charities and Corrections, 1888," p. 154–159.
[c] F. A. Woods, "Mental and Moral Heredity," New York (Holt), p. 79.

George, Horace, and Francis) as well as in collateral lines (e. g. Francis Galton) scientific ability of the first rank has been manifest.

President Roosevelt has pointed out that "race suicide" is a sign and accompaniment of coming decay. Mere numerical increase is not the whole solution, however; there must be improvement in quality also. A race that can not hold its fiber strong and true deserves to suffer extinction through race suicide. The decline of our Puritan stock, so well pictured in the genteel but worn-out Pyncheon family of Hawthorne's novel, need not alarm us if we can replace it with a new influx from the West or from the vigorous stocks of Europe.

There is one problem which concerns both the numbers and the quality of future generations, which hitherto has received practically no attention except in a partial report upon the subject in Australia. This problem is, What is now and will be the effect of voluntary childlessness upon the size and character of the birth rate and upon morals? It would be useless, here, however, to do more than mention this as one of the gravest problems in the world to-day. Ronald M. Byrnes [b] shows that the fecundity of Yale graduates has steadily diminished from 5.7 for the graduates of 1701–1791 to 2.0 for those of 1867–1886. This reduction is much greater than the reduction for the whole country, which is reported by the census to be from 5.8 in 1790 to 4.6 in 1900. Degenerates have large families. From a study of 150 degenerate families, Doctor Tredgold [c] found that the average number of children per family was 7.3, while the normal average for the country at large (England) is 4. These figures do not specify the frequency of marriage among degenerates or the mortality. Unless the one is sufficiently low and the other sufficiently high, there must follow deterioration. General reduction of the birth rate may end in depopulation. It is not unlikely that this phenomenon will be the stimulus needed to bring about practical eugenic reforms.

What eugenics might possibly accomplish is indicated by one writer in the following manner: "How rapidly the race would advance if mankind should resolve: 'The next generation must be born with healthy bodies; must be nurtured in healthy physical and moral environments; and must be filled with the ambition to again give birth to a still healthier, still nobler, generation.'" [d]

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[a] The Francis Galton Laboratory for National Eugenics, University of London, is soon to issue a "Treasury of Human Inheritance," containing pedigrees illustrating inheritance of various types of intellectual ability, of tuberculous stocks, of epilepsy, physical depravity, etc.

[b] Yale Review, November, 1908.

[c] W. C. D. Whetham, "Inheritance and Sociology," the Nineteenth Century, January, 1909.

[d] Louis R. Ehrich, "Posteritism," an address delivered at the dedication exercises of The Century Chest, Colorado Springs, Colo., 1901. For literature on eugenics, the reader is referred to the following papers and the references therein contained: "Eugenics, Its Definition, Scope, and Aims," by Francis Galton, American Journal of Sociology, Vol. X, pp. 1–6, 1904. "The Scope and Importance to the State of the Science of National Eugenics," by Karl Pearson, Oxford University Press, England. "Social Darwinism," by D. Collin Wells, Papers and Proceedings of the American Sociological Society, Vol. I, University of Chicago Press. "The Human Harvest," by David Starr Jordan, Boston (American Unitarian Association), 1907. "Eugenics," by Prof. Albert G. Keller, Yale Review, August, 1908. "A First Study of the Statistics of Pulmonary Tuberculosis," by Karl Pearson, Drapers Company, Research Memoirs, London (Delau & Co.), 1907.

CHAPTER VII.—*Conservation through public hygiene.*

SECTION 1.—*Municipal hygiene.*

Whatever improvements in heredity may sometime be achieved, the benefits of their influence can be enjoyed only by future, perhaps distantly future, generations. We of the present generation have to take our heredity as we find it. We can not follow the advice of the humorous philosopher to begin life by selecting our grandparents; but, through hygiene, we can make the most of our inherited endowment. Even such a limited effort offers large—amazingly large—rewards.

Ideal conditions for health comprise a pure and disease-free atmosphere in which to live and work; pure food and a pure water supply; protection from infection and accident; and a proper adjustment of work, rest, and amusement. Existing conditions are not only far from ideal, but also far from what might easily and speedily be attained.

That the saving power of hygiene is great is now universally recognized; that it will be greater is the hope and belief of those most competent to judge. "If hygiene were able to prolong life when it was little developed, as was the case until recently, we may well believe that, with our greater knowledge of to-day, a much better result will be obtained."[a]

There is every reason to believe that human beings are as amenable to cultivation as other animals and plants. Professor Graves, of the Yale Forest School, states that by protecting trees from infection their lives may often be prolonged a century. Domestic animals are equally dependent on care. Doctor McGee states that the growth of a colt may be stopped by giving it alcohol.

The methods of securing improvement in health conditions may be roughly classified under three groups: Public hygiene, semipublic hygiene, and personal hygiene. The first group refers to activities of the government; the second refers to activities of the medical profession and institutions such as hospitals, sanatoria, schools, and factories, and to voluntary associations; the third group deals with the private life of the family and the individual. Each of these three groups covers phases of all three branches of hygiene, viz, the hygiene of environment, nutrition, and activity.[b]

In this chapter we have to deal with public or governmental hygiene. This branch has been chiefly concerned with pure air and pure food and with organisms producing epidemic diseases. Boards of health are a recent invention, and in this country they have as yet been only imperfectly developed. They can never become the power they should be until, first, public opinion better realizes their usefulness and the fact that their cost to the taxpayer is saved many times over by the prevention of death and disease; second, more and better health legislation is enacted—national, state, and municipal; and, third, special training is secured for what is really a new pro-

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[a] Metchnikoff, Prolongation of Life, p. 144.

[b] Since this report was written there has appeared the excellent and inspiring "Civics and Health," by William H. Allen, Bureau of Municipal Research, New York (Ginn), 1909.

fession, that of public health officer—a profession already recognized in England by a special diploma.

The health officer should be supported entirely by the salary of his office and should be absolutely prohibited from practicing medicine. Not only are his duties incompatible with practice quite as much as those of judges with the practice of law, but if he gives them proper attention there is no time for other duties. No court, police, or fire department, or other agency of government, can be more important to a people than this under the complex conditions incident to the rapid growth of both rural and urban populations. It is so important that this be realized that it is worthy of serious consideration as to whether it would not be better for all imperfectly equipped and supported health boards in this country to resign—so that the authorities and people would be brought face to face with the knowledge that they have no real protection except in the emergency of an epidemic—than for existing conditions to continue.

Laboratories, research workers, statisticians, and other facilities for the performance of a national board of health's duties should be furnished in proportion to the power and wealth of the Government and the vast interests it would protect and promote. The results of its scientific and collective investigations should be constantly utilized in promoting health in the army and navy, in protecting streams and soils from pollution, in the construction of interstate waterways, in the reclamation of swamp lands, and in other public works involving health problems of supreme importance to the future of this country.[a]

Public hygiene may be studied under three heads, corresponding to our governmental divisions: Municipal hygiene, state hygiene, and federal hygiene.

Municipal hygiene and sanitation are placed largely in the hands of city boards of health, or equivalent organizations, which have power to issue sanitary regulations, abate nuisances, and even to punish infractions of their instructions by fine and imprisonment. Sanitary legislation is a product of advanced civilization. To-day not a city is without a board of health. The powers of these boards have grown, till to-day they are by no means inconsiderable; yet they must be given even greater authority, if our municipal sanitary conditions are to be what they should. Public apathy and political interference are such that health authorities can not enforce their orders. In addition to the acquirement of greater power, city health boards often need purification of motive and the banishment of political bickerings and personal jealousies.

The simplest ordinances along the line of public hygiene are those against spitting, which now remain so largely unenforced.

The smoke nuisance is another seemingly simple form of air vitiation that is receiving attention to-day. Sulphuric acid is apparently the most injurious factor. The corrosion of stone structures suggests the irritation resulting in catarrh and other respiratory mucous-membrane troubles.[b]

The effect of the introduction of closed sewers on the reduction of tuberculosis should not be overlooked. By closing sewers, impure gases have been confined, thereby removing an important source of air pollution. Some cities realize that pure air spells life and health to its inhabitants, and that pure air is a possibility only when atmospheric particles of soot and dirt are removed.

Regulations governing garbage removal, notification and isolation of disease, and the like are as a rule enforced, and new regulations are being issued constantly. Substantial progress is shown each year

[a] Letter from Dr. J. N. McCormack.

[b] See Journal American Medical Association, September 7, 1907, p. 813.

in the purification of city water supplies, in the improvement of sewage disposal, and in the bettering of drainage conditions. Streets are more thoroughly cleaned and the elimination of public and private nuisances continues without ceasing.

Our city streets have received greater care since Colonel Waring organized his "white wings" brigade in New York City a dozen years ago, thus proving the great effectiveness of clean streets in the elimination of disease. The probable elimination of the horse from our city life, through automobiles, the betterment of our trolley systems, and the introduction of subways (especially freight subways) will go far to improve our city atmosphere. The problem of city air will be half solved when our streets reach their proper state of cleanliness. The gradual elimination of the horse will tend not only to produce cleaner air, but also to reduce the dangers from flies. It is in horse manure that the common housefly ("typhoid fly") chiefly breeds. Doctor Howard attributes the termination of typhoid in certain parts of Washington to the displacement of the horse by the automobile.

Only within a dozen years has the dread importance of insect carriers of disease been realized. That mosquitoes carry malarial germs; that flies are the propagators of typhoid, cholera, and other infectious diseases; that rats breed the fleas which transmit to man the dreaded Asiatic plague[a]—all this knowledge is of recent origin.[b]

Well people are sometimes carriers and distribute typhoid, diphtheria, etc., a fact which complicates public-health regulations.

The simple reporting of all contagious disease to the health authorities immediately on its appearance is often the means of preventing an epidemic.

Smallpox epidemics are prevented both by quarantine and vaccination. Because of the outcry against compulsory vaccination, in some places the responsibility for vaccination is being thrown upon the individual. This is true in Leicester, England, and in Minnesota. Doctor Bracken, secretary of the Minnesota State Board of Health, writes that since the quarantine has been abandoned and the individual has had the option of being vaccinated or not, a larger number has been vaccinated and smallpox has diminished.

We are awaking to the importance of securing for ourselves, through our city health agencies, a pure milk supply. Great danger is also present in cream, butter, cheese, and ice cream. More than one city has inaugurated a policy of careful supervision of the milk supply. Montclair, N. J., has a well-considered plan in operation whereby the bacterial count of each dairy is public to inquirers at the board of health. This species of publicity will some day prove a strong incentive to a better milk supply. Some cities have even established municipal stations, where during the summer season sanitary milk may be purchased at cost. Doctor Goler, of Rochester, has emphasized the fact that "We employ physicians to cure children af-

[a] See Rupert Blue, "The prophylaxis and eradication of plague," California State Journal of Medicine, Vol. V, 1907, p. 304.

[b] A full treatment of the subject of insect-borne disease has been prepared by Dr. L. O. Howard, Chief of the Bureau of Entomology of the Department of Agriculture, for the National Conservation Commission. See also Charles Harrington, M. D., "Practical Hygiene," Third Edition, Philadelphia (Lea), 1905, pp. 637-660.

fected by the diarrheal diseases from dirty milk, while we permit the sale of dirty milk from filthy cattle." [a]

In Rochester, through the efforts of Doctors Goler and Roby, a few municipal milk stations were established in 1897, where during July and August milk in nursing bottles could be bought at a low price. The reduction in the Rochester infant death rate between 1897 and 1906 is doubtless due to many other conditions than the quality of milk; but the special attention drawn to the milk supply and the consequent education of the public, which probably boiled its milk when it could not get it clean, would explain a considerable part of the reduction.[b]

The interrelation of the purity of milk supply and infant mortality is shown by the following excerpt from Doctor Woodward's annual report as health officer of the District of Columbia for the year 1907:

> High as is the infantile mortality even now from diarrhea and inflammation of the bowels, it is far below the figures that formerly prevailed.
>
> The only explanation for the fall in the death rate from infantile diarrhea that I have been able to discover is the enactment on March 2, 1895, of the law regulating the sale of milk in this District and the establishment of dairy and dairy-farm inspection under the provision of that law.

The weekly report of the Cincinnati board of health for August 21, 1908, states:

> As far as we know, there has been but one death among the babies whose food supply has been obtained from the milk stations. When it is taken into consideration the large number of children we have supplied, this statement is certainly a fitting commentary upon the value of a bacteria-free and chemically pure milk.

At the recent International Congress on Tuberculosis, one delegate reported an experiment in England which has not yet appeared in print. In Liverpool the local government board tried the experiment of using pasteurized milk. The amount of illness and death in that city from children's tuberculosis is very great, yet among 1,800 children who were given pasteurized milk and who were carefully watched every week not a single case of tuberculosis developed, which seems to prove conclusively that children's tuberculosis is entirely preventable by the use of pure or pasteurized milk. This is interesting, though at variance with former opinion regarding bovine tuberculosis in children.

In this section should also be mentioned such municipal health agencies as public baths, bacteriological laboratories, and the distribution and administration of specific antitoxin, vaccine, and free medical service. Municipal inspection of local abattoirs is also important, inasmuch as federal inspection covers only establishments engaged in interstate business.

Most important of all is the matter of preventing pollution of the water supply of cities, a topic that will receive fuller treatment later in the chapter.

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[a] See George W. Goler, M. D., "Municipal regulation of the milk supply," paper at the meeting of the American Medical Association, 1907, p. 2. For conclusions based on a study of 330 milk-borne epidemics, see George M. Kober, M. D., "Milk in relation to public health," S. Doc. No. 441, Government Printing Office, 1902.

[b] See George W. Goler, M. D., "Origin, development, and results of municipal milk work in Rochester, N. Y.," Maryland Medical Journal, June, 1906.

The needs of municipal as of state hygiene are not so much new aws as better men to enforce existing laws and an aroused public pinion that will result in the appropriation of funds sufficient to nable health authorities to perform their duties in an efficient man- er. Larger appropriations will doubtless bring better men into the ublic-health service.

Section 2.—*State hygiene.*

State hygiene is necessary to supplement municipal hygiene for any reasons. One is that the country often has no other sort of anitation possible. Another is that the city is dependent on the ountry for its water, milk, and other supplies. Dr. W. G. Daggett, f New Haven, has emphasized the fact that in origin typhoid is argely a rural disease and must be combated by controlling rural rivies and other sources of infection.[a] A competent authority as- erts that "old country wells, so much valued by their owners, are positive menace to public health. Fully 50 per cent of these are nfit for use." Much of the typhoid fever brought by milk is readily raceable to such wells.

In the control of the liquor traffic the State and local units should ooperate.[b]

A state, rather than a municipal, function is the regulation of oman labor and child labor. The growth of public opinion on this oint has been rapid. In order to make the working hours meet ne physiological requirements of women, two special conditions ould be attended to. One is her monthly period; the other is child- earing. The neglect of both is responsible not only for physical npairment of factory women, but also for their inability to perform eir functions as mothers of the race. Doctor Stiles, of the Public ealth and Marine-Hospital Service, has suggested a very sensible emedy to meet the first of these conditions, and one which has met ith the approval of many factory employers. It is that each woman all have the right, once every month, to walk out of the factory ithout any questions being asked, and without loss of the day's ages. The matter is further simplified in factories provided with a atron and a rest room. In respect to the second condition—that of ildbearing—the evidence is clear and convincing. Women, on count of their imperfectly developed muscular system and more elicate physique, are unfitted for hard work; nor should they be bliged to work steadily in a sedentary position, especially at the sew- g machine, or other occupations involving the use of the lower xtremities. Special protection should be extended to them during ne childbearing period. It is a matter of constant observation that omen who have to deny themselves proper rest and care during the ext six weeks after confinement are very liable to suffer from hemor- ages and chronic uterine diseases, while miscarriages and prema- re births are not infrequent results of overwork.[c]

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[a] "The prevention of typhoid fever," Proceedings Connecticut Medical So- ety, New Haven.

[b] See "Regulation of the liquor traffic," Annals American Academy of Political nd Social Science, November, 1908.

[c] George M. Kober, M. D., "Industrial and personal hygiene," "Report of ommittee on Social Betterment of the President's Homes Commission," Wash- gton, 1908, pp. 67–68.

The employment of mothers shortly before and after the time of childbirth is prohibited in a number of European countries. American statutes, however, are almost silent on the question.[a] Professor Jevons went so far as to advocate the enactment of legislation forbidding the employment of mothers till their youngest children were at least 3 years old.

The beneficial effect on the mother, and especially on the child, of forbidding the factory to her just before and after childbirth has been proved many times. The case of M. Dollfus, a large employer of women at Mulhausen, in Alsace, has been repeatedly cited. He required mothers to remain away from their work for a period of six weeks after childbirth, during which time he paid them full wages. The decrease in infantile mortality in the first year of the experiment was from more than 40 to less than 18 per cent.[b]

The waste of vitality from unphysiological hours of work is most striking in the case of children. It is hardly to be questioned that children need longer hours of rest and sleep than adults, and that their immature bodies are much closer to the fatigue limit. A little girl in a southern mill replied to Mrs. Van Vorst's query whether she were often tired, "Why, I'm always tired." Except in unusual cases and for limited periods, child factory labor can not be defended on any hygienic grounds. The period of preparation for a wholesome, healthy life should be left free from the cares and evil physical influences of factory life. No child should run the risk of serious accident, deformity, dwarfing, or mental stunting through factory labor. It is true that in the South child labor is often the lesser of two evils, the other being the life on a farm where, through soil pollution, the child contracts hook-worm disease. Here the abolition of child labor should be preceded by the abolition of hook-worm disease.[c]

Closely connected with the restriction of child and woman labor is factory legislation in general, dealing with hours of labor, factory hygiene and sanitation, and dangers from industrial accident.

The hours of labor have for a century been on a gradual decrease. A hundred years ago fourteen and fifteen hours were by no means uncommon. The first public action regarding hours of labor was taken by President Van Buren in 1840, when he set ten hours as the limit of the working day in all government establishments. Thirty years later this was lowered by Congress to eight hours. Since 1850 the fight has been waged for a shorter day, both by labor unions and individuals; and the statutes of nearly all States contain legislation limiting the working hours of women and children in all industries as well as of all workers in certain industries, especially mining, railroading, and the more dangerous manufacturing industries. The Aldrich report of 1890[d] estimated that the American working day averaged eleven and four-tenths hours in 1840 and ten hours in 1890. Tables based upon annual reports of the Bureau of Labor show a reduction of about 4 per cent from 1890 to 1903,[e] while it is the

[a] John Spargo, "The Bitter Cry of the Children," New York (Macmillan) 1906, pp. 44–45.

[b] Spargo, loc. cit., pp. 50–51.

[c] See "Report of the Surgeon-General of the Public Health and Marine Hospital Service for 1907," relating to the investigations of Doctor Stiles.

[d] "Report on Wholesale Prices and Wages," 1890, Vol. I, p. 178.

[e] T. S. Adams and Helen L. Sumner, "Labor Problems," New York (Macmillan), 1905, pp. 516–518.

opinion of United States Commissioner of Labor Neill that the figures for 1908 would unquestionably be lower than for 1903, as the struggle for the shorter working day has been making steady progress each year.[a]

The frightful losses of life and efficiency from preventable accidents can be prevented only by state legislation.[b]

Our employer's liability acts are very unsatisfactory, because they fix no scale of compensation for injuries, but necessitate expensive lawsuits to determine in each case the sum due. A president of an insurance company doing a large business in employer's liability insurance states that of the sums they pay employers only one-quarter reaches the injured employee, who is forced to spend the other three-fourths in litigation. In England the workman's compensation acts have substituted a system of specific sums for which the employer is liable. Not only does this result in larger indemnities reaching the injured, because suits are ordinarily unnecessary, but it has the further beneficial effect of reducing the number of accidents by inducing employers to instal safety devices.

The regulation not only of the place of work, but also of the dwelling place, has come to demand action on the part of the State as well as of the community. The growth in tenement-house legislation during the past ten years has been most encouraging. Standards of sanitation for our large buildings have been raised; provision is increasingly made for good light, air, water, and for protection from fire; and the "rookeries" of old are giving way to improved tenements. Yet New York City still contains 300,000 rooms without a window.[c]

SECTION 3.—*Federal hygiene.*

The regulation of disease has increasingly become a national function. The exclusion of immigrants with infectious diseases is only one instance of this; another is the work of our Public Health and Marine-Hospital Service, which not only regulates the spread of disease from State to State, and regulates by quarantine the entry of disease from without the country, but also assists local health boards in their fights against epidemics and disease scourges. Epecially is this true in coastal cities. The Marine-Hospital Service assisted New Orleans to eliminate yellow fever and San Francisco to rid itself of bubonic plague. In addition, this service treats 50,000 seamen of the merchant marine each year, conducts a large number of hospitals and relief stations, examines pilots, life-saving crews and revenue-service men, and conducts a well-equipped hygienic laboratory.

Federal, state, and municipal sanitation are all concerned with the hygiene of transportation. To-day almost the whole American public travels, and it is therefore most important that the conveyances

[a] See Bulletin of the Bureau of Labor, No. 77, July, 1908, pp. 6–7; also, "First Annual Report on Changes in Rates of Wages and Hours of Labor in Massachusetts," Boston, 1908, pp. 592–3.

[b] The Federal Government can of course reach interstate railways. A law passed during the last session provided for a safe locomotive ash pan. Previous laws provide for automatic couplers, air brakes, etc.

[c] A. Jacobi, M. D., "The physical cost of women's work," Charities, February 3, 1907.

which they occupy, whether carriage, cab, street car, or railway train, shall be sanitary in respect to ventilation, cleanliness, toilet facilities, spittoons, dust, smoke, sleeping-car accommodations, and the like. In smoking cars, in addition to the smoke itself, the floors are usually befouled with tobacco juice and other expectoration. The efficient remedy here as elsewhere is to be found, not simply in providing facilities for cleanliness, but in fostering the present public sentiment against spitting and other untidy habits. A physician of experience maintains the opinion that "foul air in railway trains and street cars is the cause of serious poisonings called 'colds' and 'grip,' particularly in those many trains where air from the smoker sweeps through passenger cars."

The development of our national quarantine methods is indicated in the following paragraph from Surgeon-General Wyman, of the Public Health and Marine-Hospital Service:

> Until 1893 there was, properly speaking, no national system of quarantine. The colonies had their own quarantine regulations before the formation of the Union, and from that event to 1893 quarantine was left to the care of state governments and by the latter to county governments or to municipalities, as the case might be. There was, indeed, national legislation, but all the acts of Congress up to 1893 relating to quarantine specially provided that the said national measures were in aid of the state and local authorities. Whatever opinions may have been held by members of the national legislature, quarantine was permitted to be exercised by the States as a police function, and even in the present law, which gives national supremacy, it is provided that assistance shall be given the States or municipalities by the government authorities, the supremacy of the latter being asserted only when the state or local authorities fail or refuse to enforce the uniform national regulations.[a]

To-day efficient inspection at our various ports of entry and at disembarking stations abroad keeps out many cases of disease each year, while the quarantine cordon thrown around ports or municipal quarters affected by infectious disease is an important factor in stamping out such disease.

Federal meat inspection chiefly benefits the foreigner, but the administration of the pure-food laws is of value to our own people.

There are two functions of Federal Government which now are very imperfectly served and which might be made of paramount importance. They are the functions of research and of the dissemination of information. A poultry raiser, or a cattleman, or a farmer can secure scientific information to guide him in his selections of fowl, or stock, or seed by applying to the Government at Washington, but information on how to raise children has up to this time been neglected by our Government. Nothing is to-day more significant of future progress than the fact that the President, the President-elect, and many Congressmen are so strongly in favor of a greater federal organization of health. Through the dissemination of information throughout the country, through enactment and administration of effective regulations concerning pure food, inspection of meat, and exclusion of foreign diseases, through research, statistics, and through better standards for state and municipal health service, a great economy of national vitality can be effected. Washington, our national capital, might be made by the Federal Government a model city of

[a] Walter Wyman, M. D., "The quarantine system of the United States," The Sanitarian, November, 1897, p. 3. See also James W. Garner, "Federal activity in the interest of the public health," Yale Review, 1905–6, p. 181.

healthfulness, as a preliminary to its becoming a model in every other way.

Army hygiene in time of war is most important. The lack of such hygiene has shown grave consequences. In the Boer war the British army in South Africa lost more men from typhoid fever than from wounds received in battle.[a]

The efficiency of Japanese hygiene manifests itself in the fact that General Oku's army of 75,000 during the recent Russo-Japanese war had but 187 typhoid fever cases in a seven months' active campaign.

The Japanese reduced their dysentery cases from 12,052 in the Chinese war to 6,624 in the Russian war; their cholera cases from 7,667 to none; and their malaria cases from 41,734 to 1,257. This was in spite of the fact that their army in the Russian war was three times the size of that employed in the Chinese war.[b]

The crying need of better statistics is trenchantly expressed by Dr. Cressy L. Wilbur, Chief of the Division of Vital Statistics of the Census Bureau, whose words should be read and pondered by everyone who desires to see any intelligent conservation of our vital resources:

> Sound vital statistics are the indispensable basis of modern sanitation. A nation that does not consider it necessary, or that is not able, to provide adequate means for registering the births of its own children, or for officially recording the deaths of its citizens, can hardly be supposed to attach sufficient value to human life to enable sanitary measures for its conservation to be adequately carried out.
>
> For the continental United States in 1907 somewhat less than one-half of the total population (48.8 per cent) was represented in the registration area from which returns of deaths were received by the Bureau of the Census. For the remaining 51.2 per cent of the total population of the United States, estimated at 43,774,724 persons, either very imperfect laws were in effect, giving only partial registration, quite worthless for statistical purposes, or else the conditions in many States might be represented by the statement made by one of their health officers, that it buries its dead people with no more ceremony than it buries its dead dogs.
>
> As for the registration of births, a measure which is so supremely important for the knowledge of infant mortality, for the protection of infant life, and for securing the legal rights of children, not a single State in the Union nor a single city of any considerable size makes positive claim that it registers as many as nine births out of every ten that occur. Even the city of Washington, whose law for this purpose is a direct enactment of Congress, does not arise above this low limit of efficiency. The total number of births must be known before one can make a computation of infant mortality which will be comparable with the rates given in the vital statistics of all civilized nations except the United States. This ratio depends upon the comparison of deaths of infants under 1 year of age with total births, and, as we have no exact registration of births, we can not present these important statistics.
>
> In the consideration of the effect of such an important disease as tuberculosis upon the people of the United States there is no means of knowing, within a very wide margin of error, exactly how many persons die from this cause in this country during any year. We have registration of deaths for about one-half of the population only, and the very dissimilar conditions of life and the large proportion of colored population in the unregistered half seriously interfere with any attempts to guess at the exact number. Estimates have varied from 138,000 to 200,000. The truth probably lies somewhere between them, but we certainly ought to have an exact record of the facts and not be obliged to depend upon mere guesswork in entering upon an important sanitary undertaking, such as the prevention of tuberculosis.

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[a] Ditman, loc. cit., p. 17.

[b] L. L. Seaman, "The Real Triumph of Japan," New York (Appleton), 1906, pp. 106–7.

On the question of army diet, see Blackham: British Medical Journal, 1908, August 8, p. 311.

We are laboring, in conjunction with the American Medical Association, the American Public Health Association, and with the sanitary officials of as many States as we can interest, to extend the registration area as rapidly as possible. Ohio has just adopted an excellent law, which takes effect next year. Not a single State in the South has yet succeeded in reaching a satisfactory standard—not one of them in fact has even passed an adequate law. We are depending upon the voluntary cooperation of the States. The Government has no power, it would seem, to collect the statistics or to secure the proper registration of births and deaths by its direct action. If all of the important interests involved could be awakened to the importance of this matter, if Congress would take a direct interest in the accomplishment of this work, we could secure fairly complete registration of deaths for the United States within the next ten years.[a]

CHAPTER VIII.—*Conservation through semipublic hygiene.*

SECTION 1.—*Medical research and instruction.*

By semipublic hygiene is meant hygiene through nongovernmental institutions, including institutions for medical research, the medical profession, hospitals, sanatoria, associations, schools, and factories.

Medical discoveries have usually been made in the laboratories of medical schools, universities, and research institutions. The practical value of these institutions is only beginning to be appreciated. The benefits already received from them are great, and the benefits to come will be incomparably greater. One of the earliest medical laboratories, the Pasteur Institute of Paris, has done splendid work during the past two decades in the study of harmful and beneficent bacteria. Of more recent origin are the British Sanitary Institute in London, the Rockefeller Institute for Medical Research, the Memorial Institute for Infectious Diseases at Chicago, and the Nutrition Research Laboratory in Boston, under the Carnegie Institute of Washington. The recent achievement of Dr. Simon Flexner in finding a serum for the treatment of meningitis is but one example of what well-directed research under the auspices of such institutions can accomplish. The crowning achievement of science in the present century should be, and probably will be, the discovery of practical methods of making human life healthier, longer, and happier than heretofore.

The medical schools in this country number 156. They are rapidly advancing, although the great majority are still ill equipped for providing intending practitioners with the most recent and useful knowledge. The future practice of medicine depends more on the character and aims of the medical schools of to-day than on any other factor. At the dedication of the Harvard medical buildings in 1906, President Eliot laid down as the primary duties of that school the study of the prevention of disease and the education of the public. The need of such a school especially devoted to prevention has been fully discussed by Doctor Ditman.[b] Several universities have courses, or are taking steps to give courses in the fields not only of public hygiene and preventive medicine, but also of personal hygiene and home economics.

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[a] Letter from Dr. Cressy L. Wilbur. See also Irving Fisher, "Mortality statistics of the United States census," publication of the American Economic Association, 1899; and R. Dudfield, "A critical examination of the methods of recording and publishing statistical data bearing on public health," Journal of the (Royal) Statistical Society, March, 1905.

[b] See N. E. Ditman, M. D., "Education and its economic value in the field of preventive medicine," Columbia University Press, Vol. X, supp. to No. 3, June, 1908.

One difficulty in establishing such a school is the lack of students who can afford the means or the time to attend. This was the experience of the George Washington University, in Washington, when a course of this kind was offered. For this reason it is gratifying to see that an effort is being made to throw open the research laboratory of the Public Health and Marine-Hospital Service for the use of health officers detailed from their several States and municipalities. In England the degree of D. P. H. (diploma in public health) is given those who meet the high standard set there for health officers.

During the last few years the American Medical Association has been seeking to study, classify, and improve the medical schools in the United States. A large committee, of which the writer is one member, has been appointed by the association to consider methods of securing such improvements as are deemed necessary. It includes in its scope the important but heretofore little appreciated field of medical economics.

SECTION 2.—*The medical profession.*

We come next to the part played by physicians, so far as relates to their "private practice." Their work as public health officers has already been mentioned, and does not concern us here. Their work in the home is of primary importance. It is on the physician that the average man relies for protection when he finds himself in the dread grip of disease.

Private practice comprises two main divisions, surgery and general practice. The first important application of the knowledge of germs was to surgery. Antiseptic surgery, originated by Lord Lister, has resulted in the saving of untold thousands of lives and has led in turn to aseptic surgery, which is still more effective. Not only has it reduced the previous mortality from operations, but it has vastly increased the number and kind of operations which can be performed in cases which under the old régime would necessarily have proved fatal.

Of one of the most recent advances the eminent surgeon Dr. W. J. Mayo writes:

> Second only to the germ theory has been the usefulness of the great discovery of Röntgen and the application of the X-ray to surgical diagnosis. It makes certain the diagnosis in a large number of conditions which were previously a matter of speculation, and enables remedial surgical measures at an early date, lessening mortality and morbidity.
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> Another great surgical discovery is the suture of blood vessels evidenced by the work of Carrel. Its possibilities are astounding. The ability to transplant the kidney of one dog to another and have it continue its function, the amputation of a leg and its resuture, opens up the whole question of the transplantation of sound for diseased organs, especially organs which are double.[a]

In these and other surgical work a certain amount of vivisection is necessary. The present outcry against vivisection is an example of a defective sense of proportion. While needless cruelty should be avoided, the suffering of animals through vivisection, including all cases where the practice has been abused, is as nothing compared with the suffering of human beings which would be caused if all vivisection were abolished.

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[a] Letter from Dr. William J. Mayo.

The progress of antisepsis has so reformed midwifery that puerperal fever, a former scourge of humanity, is now extremely rare. In many cases the child, by being freed from gonorrheal contamination by the mother at birth, has been saved from blindness.[a]

The advance of surgery is shown by the following table of mortality of the wounded in the wars of the nineteenth century. Antiseptic surgery was introduced at the time of the Franco-Prussian war in 1870–1:

	Per cent.
Crimean war, English troops	15.2
French troops in Italy, 1859–60	17.4
German army, 1870–71	11.1
Spanish-American, 1898	6.6
Transvaal, 1900–1901	5.5

In general practice progress is also being made. The use of violent drugs is fast going out of fashion. The recognition of the self-limiting character of most of the acute diseases sounded the death knell of the harsh drugging of the olden time. Laboratory experimentation and careful study as to the physiologic and therapeutic effects of drugs have shown the necessity of subjecting everything material or immaterial, intended for the relief of human ailments, to the crucible of the most rigid scientific scrutiny. This sentiment has grown until in the best medical circles it is properly considered a reproach for a physician to use any preparation without an exact knowledge of its composition and a definite conception of the results expected from its administration. The number of medicines used by physicians is decreasing and will, if the predictions of experts in this field may be trusted, ultimately be reduced to a small fraction of the present pharmacopœia. Many medicines, like quinine and mercury, will of course merit a continuance of use. Syphilis, malaria, hookworm disease, and some other diseases are best combated by drugs.

Serum therapy, although in its infancy as to most diseases, has opened up a field of great promise. For example, antidiphtheritic serum, the one best understood and in most common use, has reduced the mortality in that disease from 50 or 60 to 12 or 14 per cent.[b] Not so much medicines or serums, but hygiene, will probably be the dependence of the next generation of physicians. Possibly the term "medicine" will some day be almost as inappropriate in describing the treatment toward which physicians are tending as the term "leech" now is in describing the physician. The profession has ceased to be hostile to hygienic treatment, and is slowly but surely substituting it for much of the internal treatment formerly employed. The new treatment includes the use of air, light, water, food, rest, massage, mechanical vibration, electricity, exercise, and suggestion, under the names of aerotherapy, hydrotherapy, psychotherapy, etc. These remedies have the great advantage of preventing as well as curing disease.

It only remains for all medical schools and the courses of lectures now gratuitously provided by the American Medical Association for all county medical societies to teach these things in such a thorough and practical way as will reach the whole profession and bring these

[a] Elie Metchnikoff, "The Nature of Man," New York (Putnam), 1903, p. 210.
[b] Metchnikoff, "The Nature of Man," p. 212.

benefactions to the whole people. In proportion as prevention is more important than cure, the rapid advance in the knowledge and practice of preventive medicine will be of value.

"To hygiene belongs without a doubt the place of honor in modern medicine. It is in the prevention of infectious diseases that the interest of the medical art is now mainly centered."[a] The best men are turning to these physiologic methods with enthusiasm.[b] They are learning to take into account the anxiety and other mental reactions of the patient as to what is said in his presence.[c] They are becoming more public-spirited and cooperative,[d] and alive to their responsibility to set patients a good example in living hygienic lives.[e]

The trend toward prevention is indicated in various ways—by the fact, for instance, that some physicians are now employed by families, schools, firms, associations, etc., for the purpose chiefly of preventing rather than curing disease. Women dentists graduating from the University of Michigan have made a practice of attending to children's teeth at a stated amount per month. Employers are increasingly securing the services of competent physicians to care for the health and physical welfare of their employees. This is a preventive measure, and has been found to be a "paying proposition" to the employer because of the resulting enlarged efficiency of the workers.

Their modern fight against tuberculosis has led physicians to a larger use of fresh air in their practice. At first many employed this agent merely as a "specific for tuberculosis," but its utility in all chronic ailments, such as neurasthenia, for instance, was next recognized. Latterly, fresh air has been discovered to be of use in pneumonia and other acute diseases. It is now not unusual to find physicians advising their patients, whether ill or well, to sleep out of doors. There can be no question that man was originally an outdoor animal.

The discovery of the germ origin of Asiatic cholera, tuberculosis, diphtheria, typhoid fever, bubonic plague, influenza, and other diseases, and of the part played by water, impure food, insects, rodents, and other common and almost omnipresent, but hitherto unrecognized, agencies as carriers of disease to man and animals, has awakened a world-wide interest in these subjects which, properly fostered and directed, opens up ever extending possibilities to the humanitarian, the economist, the statesman, and, still more, to the people at large.

The consequence must be a great revolution in medicine in the immediate future. The practice of medicine is destined to become a much more powerful agent than ever before in the suppression and prevention of disease. This result will be reached when the change now going on permeates the rank and file of the profession. It would be a pity if, through undue conservatism of some of its members, the profession should lose some of its prestige hard won during the last generation. Already the ever-present quack is pressing into the inviting field. As the public demands "drugless treatment" and many

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[a] Metchnikoff, "The New Hygiene," Chicago (Keener), 1906, pp. 12–13.

[b] See G. Stanley Hall, "Adolescence," New York (Appleton), 1905, vol. 1, p. 238.

[c] See A. T. Schofield, "Power of Mind," London (Churchill), 1902, 2d ed., p. 277.

[d] See Osler, "Maryland Medical Journal," October, 1905, p. 420.

[e] See Professor Osler's address to St. Mary's Hospital, London, 1907.

physicians fail to see and meet that demand so far as it is rational, the quacks see their opportunity. As a consequence, there is fast developing a species of quack that not only does not use "patent medicines," but condemns their use by regular physicians. Men of this type base their appeals on "naturopathy," become "food experts," prescribe fasting, or two meals a day or five meals a day, give lessons in "deep breathing," conduct outdoor sanatoria, and employ light and air baths, dry cupping, mechanical vibration, intestinal lavage, water cures, electricity, osteopathic manipulations, "divine healing," etc. All these methods have value under certain conditions; the only objection is that when applied by the uneducated they are utilized to poor advantage. The fault lies not in the therapeutic means but in those who use them. Physicians sometimes confuse the two, and make the mistake of opposing the means and user alike. They reject good means of cure because employed by "irregulars."

The result is that the patient sometimes finds the best means of recuperation in the hands not of medical men, but of uneducated "physical trainers." The public will go and should go to those who will render the most effective help. In order that the medical profession may suppress quackery the way must be not to oppose the use of beneficial therapeutic agents in incompetent hands, but to get their use into competent hands by adopting them themselves. There is a quackery that is villainous and injurious. This should be suppressed. But there is another quackery which is well intentioned and which, in spite of ignorance, manages to do some good. The good in it should be appropriated by the profession. By always promptly absorbing the best the profession will be in a position to cast out the worst in "irregular" systems of therapeutics. It may then recover the ground which it has too often lost. There was no reason why it should have lost hundreds of thousands of patients to "Christian Science," except that these patients were for the most part benefited, and greatly benefited, by Christian Science after having received no benefit, and often injury, from the profession. "Easily physicians, without knowing it, can produce sickness by pessimistic prophecies, by anxious looks or words. Thus are diseases suggested (unconsciously) by the physician."[a] Had the profession made use of mental therapeutics not only could they have saved themselves the enmity of these hundreds of thousands, but they could have nipped in the bud the crude metaphysics which teaches the nonexistence of disease and death and the uselessness of any therapeutic agent except those employed by the promulgator. The example of so-called "Christian Science" is only one of several protests, more or less misguided, against the present practice of medicine.

Had all or most members of the profession conceded long ago the harmfulness of many, if not most, violent drugs it might have forestalled the present antidrug movement among the laity. The misguided antivaccination movement is simply the carrying to extremes of the antidrug movement.

The Greeks were probably the most hygienic people that ever lived and they knew nothing of modern scientific medicine, not even of the circulation of the blood. This shows that man's primitive knowl-

[a] Schofield, loc. cit., pp. 215–216.

edge or instincts may be sufficient to enable him to keep and develop health.

The old code of medical ethics, though well-intentioned, was so inelastic and was so susceptible of misconstruction as often to block the way to progress. The magnitude and far-reaching effects of this evil were long ago recognized by leading minds in the profession, and after years of agitation such a revision was unanimously agreed upon in 1903 as makes the modern principles of medical ethics purely advisory and far more liberal than formerly. All restrictions as to consultations were removed, medical societies were thrown open to reputable physicians of every school of practice requiring scientific training, and agencies put in operation for such organization and cooperation and to encourage such liberty of individual opinion as is demanded by the spirit of the age. Under the most active efforts of the medical schools, societies, and journals it will doubtless require years of time for this liberal spirit to reach all members of the profession to the extent which is so desirable. But when this is done and when the public can be made to understand that it has been done the prejudice which has hampered the profession's usefulness, which has made it so difficult to secure and enforce health and medical legislation necessary for the protection of the highest interests of the people, and which has so fostered and given opportunity for quackery, will gradually become ancient history.

A frequent lay comment on some members of the medical profession is that to be true teachers of health they must practice what they preach. A physician can not succeed in controlling drug habits or alcoholism if he has these habits himself. He can not fight "patent medicines" if he uses them himself.[a] He can not effectively fight the social evil if he himself practices abortion. The standards of the profession are high. It is the individual who is at fault. A clergyman who preaches purity from the pulpit while living a double life is disgraced. In the same way, now that physicians are assuming the function of giving instruction in orthobiosis and hygiene, they are being called to account for their own daily lives. Self-interest and altruism alike will lead to needed corrections. The physician in these days of preventive medicine should keep himself well. The challenge "Physician, heal thyself" is being followed by the challenge "Keep thyself well." Example more than precept is a principle to be applied here as elsewhere. He can not induce his patients to diet or take exercise if he himself is addicted to the fleshpots and the easy chair. Many a physician to-day loses patients because he and his family are on the sick list, or because as a man he practices habits which as a physician he does not approve.

The physicians in this country now number about 130,000. Their calling is in some respects the noblest in the world to-day. During the present generation the profession has begun to be appreciated for its great services to public and private health and for its self-sacrifice, which is unequaled in any other profession except the ministry. It has now before it an opportunity such as never before existed. Those of us who believe in its mission look forward to incalculable blessings to suffering humanity from greater knowledge better applied.

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[a] See A. Jacobi, Journal American Medical Association, September 29, 1906, p. 978.

SECTION 3.—*Institutional hygiene.*

The large cities have established special contagious hospitals, where prompt isolation of infectious cases may be enforced. The decrease of tuberculosis may be traced largely to hospital isolation.[a] Leprosy was the first disease to be quarantined [b] and its virtual disappearance in civilized countries has been due, at least in the opinion of many authorities, to the strict isolation methods universally adopted.

Of a different kind is the segregation of defective classes of the community. This has led to considerable conservation of their powers and abilities. Institutions for the deaf and blind in the United States contained 14,700 inmates in 1904, and spent for purposes of maintenance over $3,500,000.[c] In these schools the deaf and dumb and the blind are taught trades and professions, their usefulness being thus much enlarged.

The New York state commission on the blind recommended in 1907 a state board for the blind to conduct an employment bureau for the blind of that State, to establish schools, and to put into operation measures for the prevention of blindness. It is pointed out that of the 100,000 cases of blindness in the United States a great percentage is traceable to disease and accident of a preventable character. The commission estimates that of 1,000 cases in New York, 450 were possibly avoidable and 325 (or one-third) certainly so.

For the checking of insanity the crying need is a study of the causes of the malady with a view to its prevention. For, as Doctor Ditman remarks, nine-tenths of the inmates of our insane asylums are incurable, according to our present knowledge. He adds: "What an argument for the prevention of the disease!"[d] Much may be expected from the Phipps fund, for the study of insanity, recently established at Johns Hopkins University.

In the first place, our medical students should receive constant clinical instruction in mental diseases, particularly in their incipient stages. Almost equally important are popular lectures on the preventable and other causes of insanity given under the auspices of medical schools or local boards of health. Such lectures have been given in New York and Boston, and, judging by the attendance, must prove a valuable agency in diffusing a correct knowledge of the cause and development of mental disease. In this education of the laity popular treatises on mental hygiene would prove most helpful. Such a book as Doctor Clouston's "Hygiene of Mind" could, with advantage, be placed in the hands of every young person, and might even be adopted as a text-book in high schools. Certainly the physiology of mind is as deserving of popular consideration as that of digestion, respiration, and the circulation.

By a clearer insight into the beginnings of mental disease, gained through the popular lecture and a nontechnical literature, society will become so far enlightened that intelligent personal prophylaxis

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[a] See Newsholme, "Phthisic death rate," Journal of Hygiene, July, 1906.

[b] See J. M. Eager, M. D., "The early history of quarantine," Yellow Fever Institute Bulletin No. 12, pp. 4–5.

[c] Census report on "Benevolent institutions," 1904.

[d] Ditman, loc. cit., p. 46.

may be anticipated.[a] A knowledge of danger is the surest means of guarding against it. "The most obvious line of attack must be in the direction of the four great etiological factors of insanity, heredity, alcohol, syphilis, and environment. Abstractly considered these four causes are preventable or removable."[b]

As an intermediate step between home and hospital, the sanatorium offers both cure and prevention. Many tuberculosis sanatoria will take patients only in the incipient and early stages of the disease. Sanatoria are used by many as places of recuperation. The tired business man and the nervous housewife find at the sanatorium the quiet they need, and a week or two of rest enables them to escape threatened serious ills.

Many public institutions, in response to popular demand, are today installing methods and equipment that are essentially preventive. More than one department store in the large cities filters its air in order that patrons and clerks shall not feel oppressed by vitiation of the atmosphere. An indirect result is the prevention of tubercular and other diseases. A leading hotel in Philadelphia has pitched tents on its roof, where a large colony of well people—not sick—sleep out of doors, and the same hotel utilizes its roof in winter for a skating rink. Mothers' clubs are an increasing factor in the spread of a knowledge of hygiene. Recently a case came to light of a new member of a mothers' club who was feeding her 5-months-old baby on sausage, tea cake, etc., and giving it drugs when she wanted to go out. She was greatly surprised when informed of the wrong she was doing.

Growing interest in the science of home economics, already referred to, is an indication of our increasing realization of the importance of healthful homes in the community. While the number of schools and colleges which offer courses in higher domestic science, and in what might be called "true home economics," is growing, they are nevertheless still comparatively few. More teachers should be equipped with scientific knowledge regarding modern sanitation in order that they may give practical courses in grammar and high schools, and higher instruction should include the topics of hygiene and sanitation. Home making may be studied in many details, such as the construction of healthful houses, the purification of food and water supplies, and the cleansing of cities, whereby the enlistment of both boys and girls in all lines of home and municipal hygiene can be secured.

The churches are now joining in the health movement. The lead has been taken by the Rev. Elwood Worcester and Rev. Samuel McComb at the Emanuel Church in Boston. Trained physicians are employed for diagnosis and for general advice, but great emphasis is laid on the power of suggestion and of Christian self-control over bodily ills. The object is to get both patient and physician to stop "thinking sick and talking sick," as Doctor Goler has put it.

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[a] A book which brings the subject home with unusual force to the ordinary reader is an autobiographical sketch by a recovered patient, "A Mind that Found Itself," by Clifford W. Beers, New York (Longmans, Green), 1908.

[b] Charles P. Bancroft, M. D., "Hopeful and discouraging aspects of the psychiatric outlook," address at meeting of American Medico-Psychological Association, Cincinnati, 1908.

SECTION 4.—*School hygiene.*

In every progressive country to-day the hygiene of school life is coming to be regarded of paramount importance. At the International Congress on School Hygiene, in London, August 5–10, 1907,[a] there were in attendance at least 500 delegates, representing the governments of the world and societies devoted to the advancement of human welfare, and in addition there were 1,500 individuals interested in the improvement of the health of school children and all that this implies. The fact was brought out at the congress that European countries, notably Switzerland, Germany, France, England, and Scotland, are doing more than the United States in the medical inspection of schools and that they are seemingly making plans for the improvement in every direction of the hygienic conditions of school life.[b] Even in Italy the leading statesmen are apparently convinced that the matter of chief importance at the present moment in their educational work is to place it, from start to finish, upon a hygienic basis.[c]

It is the unanimous opinion of all students of the matter that the neglect of the hygiene of school life in the larger sense is, first of all, more or less disastrous to a considerable proportion of the pupils.[d] With us, as well as in most European countries, children are compelled by the state to attend school for a number of years. Many of them suffer constantly from defective vision, hearing, and respiration, from nervous overstrain, and from other ailments which are greatly aggravated by the confinement and stress of school life.[e] Pupils are always exposed to infectious diseases. It is no unusual thing in our country to see a contagious disease sweep through a whole school so rapidly that the local board of health can hear of it and order the school closed only after the harm has been done.

Great as is the injury done by the spread of infectious diseases to children thus massed together in schools, the injury resulting from imperfect seating, lighting, ventilation, and sanitation of school buildings is still more serious. In every part of our country, as well as in the progressive countries of Europe, those familiar with

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[a] The proceedings of the congress contain papers by distinguished physicians and educators upon every phase of the hygiene of school life. Existing evils are pointed out and remedies suggested. Summaries of the papers may be found in the Nineteenth Century, September, 1907, pp. 388–394.

[b] In addition to papers presented at the International Congress on School Hygiene, see the following: A series of articles in the School Review (University of Chicago) for 1907, by Prof. Hermann Schwartz, entitled "The study of experimental pedagogy in Germany." Many articles in the magazine Zeitschrift fur Schulgesundheitspflege show the great interest in Germany in school hygiene. Professor Binét, of Paris, has established a laboratory for the study of childhood in relation to educational work, and he will give particular attention to problems concerning physical defects and mental and moral shortcomings. For other such institutions see The Psychological Bulletin, Vol. VI, March 15, 1909, pp. 84–103.

[c] See, for example, Professor Garlanda's "Il Terzia Italia," in which ne shows the only way in which Italy can regain her old-time vigor and efficiency.

[d] See M. V. O'Shea: "Dynamic Factors in Education," New York (Macmillan), 1906, Part II, where the whole subject is discussed.

[e] See Oppenheim: "The development of the child," Chap. V. Also Tyler: "Growth and education:" Burbank: "The training of the human plant;" Burk: "From fundamental to accessory," etc.; Pedagogical Seminary, Vol. VI. Kræplin: "A measure of mental capacity," Popular Science Monthly, vol. 49.

the situation are appealing most urgently for improvement in the physicial basis of education. This is not the place to recite the disabilities which are said by men competent to speak on the subject to result from keeping children for at least eight years in confinement and at hard mental labor under conditions that waste their vitality and develop bodily defects and habits prejudicial to health. The list of such disabilities is a long and impressive one.[a] Unfortunately, we do not, as a people, sufficiently appreciate that the character of social life with us is changing rapidly, and that consequently our children are particularly susceptible to certain diseases and defects; to wit, those arising from the adoption of an indoor life of comparative muscular inactivity, with greatly increased demands made upon particular organs, such as the eyes and the brain.

Doctor Cronin, of New York, maintains that in a school population of 650,000, 30 per cent of the children were from one to two years behind their proper class. Ninety-five per cent of these backward children were so principally because of defects of eye, ear, nose, or throat, which could easily be detected and remedied through effective medical inspection. Experiments at home and abroad have proven beyond any doubt that the majority of children of this sort, when given proper medical treatment, improve markedly in intellect and general conduct. The State attempts to educate these children, but its effects are to a large extent wasted. Doctor Osler calculated that in the special city to which reference has been made there was, on account of a lack of medical supervision of educational work, a yearly financial loss of $1,666,666; and of course the loss which came from moral deviation due to defective physical functioning was of far greater importance. Doctor Osler said recently, in effect, that he considered it of greater importance to the nation that the question of sound teeth be intelligently considered than that the consumption of alcohol be restricted, important as the latter problem is. In similar vein, Doctor Newton reports a case of an old, unhygienic school building in a small town being fitted up with a ventilating system, with the result that the cost of the improvement was saved in a short time in salaries that otherwise would have been paid to extra teachers for taking the place of those made sick by the foul air in the building.

We now know the major effects at least on intellect and temperament of sense defects, adenoids, decaying teeth, and minor physical deformities; and we also know how such deviation from normality can be readily and inexpensively detected and remedied,[b] but there are whole States where no advantage whatsoever is taken of this knowledge, and in practically every State in the country there are communities in which absolutely no attention is paid to any of these matters. The people go on in traditional ways, trusting to luck and disregarding the changes taking place in society.

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[a] See Shaw: "School hygiene;" Keating: "Mother and child;" Ballantyne, in the Lancet, Vol. 2, 1890; Bancroft: "Physical Education Review," Vol. VII; Rowe, "The lighting of schoolrooms;" Burrage and Bailey: "The Sanitation and decoration of school buildings." The Magazine of School Hygiene, published under the direction of the School Hygiene Association, contains in each issue articles showing the evils resulting from unhygienic conditions in the schools.

[b] See, for example, two books by Doctor Warner, of London: "The Study of Children" and "The Nervous System of the Child." The city of Chicago maintains a department for the study of backward and defective children in the public schools.

The health of our school children, then, should be conserved by a system of competent medical inspection [a] which should secure the correction of defects of eyes, ears, teeth, as well as defects due to infection or malnutrition. In Europe—

all the investigations disclosed an astonishing amount of ill health among school children; and though the variations from the normal were found to differ in degree, they were on every hand alike in kind. In nearly every instance they were more pronounced in girls than in boys, and were often most manifest in scholars of the better social classes. Thus there were discovered the following percentages of morbidity among school boys: In Great Britain, 20; in Denmark, 29; in Germany, 30; in Copenhagen, 31; and in Sweden, 37. The percentages noted among the girls were: In Great Britain, 16; in Copenhagen, 39; in Denmark, 41; in Lausanne, 43; in Germany, 50; and in Stockholm, 62—an average morbidity for boys of 29 and for girls of 42 per cent.[b]

Similar results have been reached in certain cities of the United States. A "committee on the physical welfare of school children" in New York City examined New York school children and found that [c]—

66 per cent needed medical or surgical attention or better nourishment.
40 per cent needed dental care.[d]
38 per cent had enlarged glands of the neck.
31 per cent had defective vision.
18 per cent had enlarged tonsils.
10 per cent had postnasal growths.
6 per cent were undernourished.

Dr. Walter Cornell has been making an extensive study of eye strain among school children. These were his findings: [e]

The relationship of poor vision to scholarship was studied in 219 children. As will be noticed, the difference in marks between those with normal and those with bad vision is greatest in arithmetic and spelling, which studies require more extensive use of the blackboard.

Scholarship percentages obtained.

Children with—	Arithmetic.	Geography.	Spelling.	Average.
Normal vision	79	69	76	75—
Fair vision	70	71	77	73+
Bad vision	66	70	71	69

In New York City 29.5 per cent of 79,069 children examined suffered from defective vision. In London 26 per cent of 20,000 children examined by eight

[a] See Gulick and Ayres. "Medical Inspection of Schools," Russell Sage Foundation Publication, New York, 1908; see also "The Psychological Clinic," especially Vol. ii, No. 8.

[b] G. Woodruff Johnson, M. D., "Effects of school life on children's health," North American Review, vol. 182, p. 831.

[c] Ditman, loc. cit., p. 41.

[d] This seems a low estimate in spite of the fact that it does not include all cases of decayed teeth, but only those that have been neglected. See Dr. William R. Woodbury, "The People's Disease: How to Prevent it," Boston Medical and Surgical Journal, March 26, 1908.

[e] "Backward Children in the Public Schools," Philadelphia (Davis), 1908, p. 7.

ophthalmologists had defective vision, and of this number 12.5 per cent suffered from vision of one-half or less. The author examined personally 1,156 children and found 34 per cent with defective vision, and of this number 6 per cent with vision one-half or less. A small proportion of this number only is fitted with glasses. The rest suffer from real eye strain. The fault of this deplorable condition is divided among physicians, school-teachers, and parents. Ignorance of the existing facts, indifference, and poverty are the real factors to be dealt with.

Eye strain is the chief source of the functional diseases of our citizens. It begins in early childhood and continues until senility is complete. It is bound to occur in every individual some time in his life, to a greater or less degree. It is almost the sole cause of headache, migraine, sick headache, the most frequent and habitually morbidizing of human diseases. It is the frequent cause of gastric and digestional diseases and of nervous and mental diseases. With ocular function it conditions the origin of spinal curvature, either directly or indirectly, through the pathogenic writing posture. Lateral spinal curvature, the effect of visual function, becomes a new secondary source of multifarious morbidities, such as neurasthenia, pelvic diseases, hysteria, etc. It has been demonstrated that 27 per cent of European school children have lateral spinal curvature at the age of 14, and I have proved that at least 70 per cent of our own 16 to 18 year old young men of the educated classes have this disease. Surprise at the fact will soon become horror at the national and social tragedy which these true figures indicate.[a]

Investigations in other cities and States[b] have shown similar results, in view of which it is a conservative statement to say that from one-half to two-thirds of our school children need medical treatment of some sort.

At least one year in each division of schooling, elementary, secondary, and collegiate, is lost to the majority of students because of unnecessary sickness or dullness caused by improper living.[c]

That physical defects are responsible for much of the backwardness of children, and for a large share of truancy and incorrigibility, is the opinion of many educators.[d] In order to correct physical abnormalities and thereby to hasten mental and moral progress in school life, a number of cities have instituted medical inspection of schools.

So far as inquiry has been able to discover, there were in the month of June, 1908, 70 cities in the United States, outside of Massachusetts, having some form of medical inspection of schools. In the State of Massachusetts 32 cities and 321 towns had systems more or less complete. It is at present impossible to compute, or even to closely conjecture, how many children these systems reach at the present time. It is entirely certain that they do not reach all of the children in the schools of those cities and towns where systems of medical inspection are actually or nominally in operation.[e]

New York City employs 150 physicians, who visit each public school once a day, shortly after 9 o'clock, to examine those children set aside by the teacher

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[a] Letter from Dr. George M. Gould, who perhaps more than any other American has emphasized the evils of eye strain.

[b] See an article by Prof. M. V. O'Shea in the World's Work, Vol. V, in which the results of extensive investigations were given. See also Dr. W. B. Drummond: "An introduction to child study," Chs. IX and X, "Report of Conference of State Sanitary Officers of New York," Buffalo, October, 1907, and various Baltimore and New York City school reports.

[c] Letter from Mrs. Ellen H. Richards.

[d] See O'Shea: "When character is formed," Popular Science Monthly, Vol. LI; Rowe: "Physical nature of the child," Chs. 9, 10, 13, 14; Scott: "Sacrifice of the eyes of school children," Popular Science Monthly, October, 1907; Gould: "The cause, nature, and consequences of eye strain," Popular Science Monthly, December, 1905; Travis: "The Young Malefactor, a Study in Youthful Degeneracy;" Swift: "Mind in the making," Chs. IV and V; Tanner: "The child," Ch. III; Kirkpatrick: "Fundamentals of child study," Ch. XVII.

[e] Letter from Dr. Luther H. Gulick.

as requiring attention. Chicago employs nearly 100 physicians to visit her public schools. In Chicago during the ten months of the school year ended June 26, 1908, the medical inspectors of schools examined 406,919 pupils.[a]

And one health officer, Doctor Chapin, of Providence, has even established a special fresh-air school for children who suffer from certain forms of tuberculosis or who come from tuberculous families. He says concerning it:

Our fresh-air school has only been running since last January (1908), and, of course, we have no very definite results. All of the children without exception improved in health, and gained in strength, and also showed good mental progress. The cost of the school per capita is only about 50 per cent more than in the ordinary schools, and we believe that the expense is fully justified. If we had a large enough school, so that it could be graded, the cost of education would, owing to saving in fuel, probably be less than in an ordinary school.

Several States are making progress in these directions.

Connecticut, Massachusetts, and Vermont have passed laws making examination of eyes, ears, and method of breathing of the public scholars compulsory, while New York, Illinois, and some other States of the Middle West depend upon the voluntary cooperation of the teachers in making this examination. It would seem, however, that whether it remains voluntary or becomes compulsory, its success will be greatly enhanced if women who are conducting teachers' institutions in the department of education devote a half hour or an hour to the exposition of the necessity of such an examination and also in explaining the method in detail and the method of tabulating the results, so that the teachers may be familiar with the tests, etc., when they have to make them. With the great power lodged in the department of education in this State, it would seem justifiable to make this compulsory.[b]

We in this country should profit by the experience of older countries in respect to school hygiene. Switzerland has led the nations in its concern for the physical welfare of its children. A number of other European countries are beginning to imitate Switzerland in attaching supreme importance to health and hygiene in educational work. There is now before the English Parliament a bill the purpose of which is to establish a national system of medical inspection of schools, and it seems probable that this measure will be enacted into law.

It is generally recognized by physicians and educators to-day that many children in the schools are being seriously injured through nervous overstrain.[c] Throughout the world there is a developing conviction that one of the most important duties of society is to determine how education may be carried on without depriving children of their health. It is probable that we are not requiring too much work of our pupils, but they are not accomplishing their tasks economically in respect to the expenditure of nervous energy. Some experiments made at home and abroad seem to indicate that children could accomplish as much intellectually, with far less dissipation of nervous energy, if they were in the schoolroom about one-half the time which they now spend there. German educators and physicians are convinced that a fundamental reform in this respect is needed. In fact, among school children we are learning the same lesson as

[a] A. L. Craig, "Report of the standing committee on contagious, infectious, and hereditary diseases," Associated Fraternities of America, August 1, 1908.

[b] Twenty-eighth Annual Report State Board of Health of New York, 1908.

[c] See Dr. Adolph Meyer, "What do Histories of Cases of Insanity Teach Us Concerning Preventive Mental Hygiene during the Years of School Life?" The Psychologic Clinic, June 15, 1908.

among factory employees, viz, that high pressure and long hours are not economy but waste of time.

In American cities one of the greatest needs to-day, in order to conserve the vitality of children, is the establishment of playgrounds easily accessible to all the children of any community. We are told that the physical and the mental are inseparably joined together, and if the one is defective the other will suffer through sympathy. Now it appears to be impossible to develop the child physically in any way so effectively as through active play. Formal gymnastics can accomplish relatively little. The child must have some end to attain that arouses its enthusiasm, and that demands agility and strength and endurance; then its whole bodily mechanism will work together in harmony to achieve this end. And this is what a physical training seeks to accomplish—to make the body a fit instrument for the mind. Let the child have some place where it may not only play games freely without fear of the police but where it may run and jump and climb and swing and work in sand and throw stones and wrestle, and it will not fail to make the most out of the body nature has given it as a housing for a sound and efficient mind.

Even if playgrounds were of no value in social development, they would still be of inestimable service in keeping children out of crime and lessening expense for police, courts, reformatories, hospitals, and prisons—a point which was strongly emphasized in the report of 1897 of the committee on small parks in New York. If a boy's energies are not used up in wholesome activity they will surely find expression in illegitimate conduct. The boy will prey upon the institutions which prevent him from living a natural life. "The greatest enemy to the police is the boy," said a high Philadelphia official recently. Go to the storekeeper, to the shopkeeper, to the housekeeper, and you will hear the same story. The boys steal, break windows, insult, afflict, upset one thing and another, and would do almost anything they hear or see in order to satisfy that burning instinct for play. "These beginnings of vice and crime were the only outlets they have had for the powers with which nature has endowed them. These practices were their only or chief amusement, and thus happiness to them became synonymous with vice and fiendish delight in evil doing."[a]

But in studying the life on the playgrounds the same official sees that they lay the foundations for—

> strong, manly, bright, and happy lives, rescued from the evil habits and tendencies that produce misery and wretchedness. * * * Through their play in this manner the young are taught how to live together, how to respect each other's rights, how to be kind, gentle, pure, in language as well as in conduct. The boy's mouth is not defiled by tobacco, liquor, or profane language. The disrespectful and vulgar treatment which young boys and girls inflict upon each other in the street is done away with. The playground influences are brought into the home, where the younger brothers and sisters treat each other much differently from the way they do now; or, to put it the other way, the influences of the home, the school, and of the church are thus extended outside over the whole life of the child.[a]

To playgrounds may be joined school gardens, which Superintendent Maxwell in New York has shown would not be expensive,

[a] Secretary of Philadelphia Culture Extension League.

or open-air gymnasia, or any other equipment that will give children the opportunity to develop physically.

Physical education is a part of the training in many public schools and in a still greater number of private schools, but there is room for improvement. After pointing out, in a recent article on physical deterioration, that Germany, France, and Austria have improved their physical development by compulsory physical training in all civil and military educational institutions, the Rev. Percy Stickney Grant advocates the instalment in the United States of:

1. An effective system of physical education as a recognized part of all public-school systems. By "effective" I mean one that does for a boy, as far as his physique is susceptible, what army setting-up exercises do for a recruit.
2. Athletic exercises in schools, using gymnasia, baths, etc.
3. Open-air exercises and sports under efficient supervision.
4. Summer camps free of cost, and compulsory attendance for boys of school age.[a]

The study of hygiene and physiology has been part of the public school curriculum for some time, but has been regarded by physiologists as a somewhat partisan and unscientific treatment of the physiological effects of alcohol and tobacco. It should be recognized, however, that it has had a salutary effect and has given school children a better idea of what alcohol means than the most of them had before.[b] Local topics of sanitation may well be taken up, as in New Haven last year when the interest of all the city school children was enlisted in behalf of a "clean city." Doctor Stiles, of the Public Health and Marine-Hospital Service, has proposed an annual "health week" in the public schools, and this proposal has found favor in several States. In Georgia Chancellor Barrow has proposed an annual "health day" in the public schools of that State, which would be devoted to lectures on sanitation, on the dangers to be expected from unscreened windows, and on the character of the hook-worm disease, with suggestions as to its elimination.

At present the schools look to parents to instruct their children in the supposedly simple matters of regulating eating and drinking, exercise, habits of work, and sexual habits, while the parents vaguely hope (if they think about such matters) to be relieved of these embarrassing duties through the schools. The truth is that neither parents nor schools are to-day able to give this much-needed sort of education. The remedy must be provided by the schools, which in their eagerness to impart conventionalized facts are now quite blind to some of the most pressing needs of their pupils. Through the schools and universities (or other appropriate organizations) the parents of the future must be educated both as to the facts and the moral aspects of bodily hygiene. And it seems not unreasonable to hope that some of the lessons now learned only by bitter experience, after much that is best in life has been sacrificed to ignorance and uncurbed impulse, will be assimilated sufficiently early in life to mitigate materially the lot of a not inconsiderable part of mankind. I believe the lengthening of the span of human life to be among the attainable results of such teaching. Is it not likely that as men grow wiser an increasing number will deliberately strive so to regulate their lives as to improve the expectation of crowning well-spent days with the peculiarly fine satisfaction of old age?[c]

If the school building were a model of ventilation, lighting, and sanitation, it would not only conserve the health of the school chil-

[a] Rev. P. S. Grant, North American Review, February 1, 1907.

[b] See Dr. Helen Putnam, "Studies of the Present Teaching of Hygiene, Through Domestic Science and through Nature Study," American Academy Medicine (Easton, Pa.), 1905.

[c] C. A. Herter, M. D., "The Common Bacterial Infections of the Digestive Tract," New York (Macmillan), 1907, p. 351.

dren, but also serve as an object lesson for hygienic instruction. In the same way cooking and domestic science classes could be made to serve the double purpose of providing a hygienic noon meal and training the school children, especially the older girls, in the principles and practice of this vitally important subject. Our schools are suffering from the conventional idea that education comes from books. Education is preparation for life, and should make use of every efficient method and element, manual training, athletics, observational nature study, laboratory experiments, and object lessons of all sorts, as well as book instruction.

SECTION 5.—*Voluntary and business organizations.*

A host of distinctly voluntary associations are working for the improvement of hygienic conditions. Among them may be mentioned the National Association for the Study and Prevention of Tuberculosis, the Society for Sanitary and Moral Prophylaxis, the Chicago Society of Social Hygiene, the Connecticut Society of Mental Hygiene, the national and state child labor committees, the Congress on School Hygiene, the Children's Aid societies, the Sunshine societies, the American Playground Association, the Visiting Nurses' Association, the Red Cross Society, the American Association for Labor Legislation, the numerous temperance organizations, university settlements, institutional churches, Young Men's Christian Association and kindred associations, the American Physical Education Society, the Boston Health Education League, and the American Health League established by the Committee of One Hundred on National Health.

That various large bodies of men are waking to the importance of health study is shown by the appointment, at the last annual meeting of the Associated Fraternities of America, of a committee on infectious, contagious, and hereditary diseases, with Doctor Craig, of Chicago, as chairman. Labor unions may well follow this example and provide for the education of their members in the subject of hygiene. This could be effectively combined with their endeavors to shorten the hours of labor. Especially unhygienic is the arrangement by which a man has no interest in his work beyond that represented by his pay envelope. This fact has been recognized by some farsighted employers of labor, with the result that they now employ social secretaries or "welfare workers" to look after the general well-being of employees. A social secretary watches over the health, comfort, and happiness of the force during working hours, establishes lunch rooms, rest rooms, mutual aid associations, thrift funds, and penny provident banks. Employers, as a rule, become eager for practical suggestions and expert advice on the well-being of their employees as soon as the matter is called to their attention. Doctor Favill, president of the Chicago Tuberculosis Institute, after speaking before the Commercial Club, was urged by 15 or 20 of the large employers present to undertake investigation of their establishments and to make recommendations.

Dr. Hubert Higgins describes an interesting experiment carried out in a mill near Paris, where there were employed 44 men and 75 women and children. A medical officer was employed to supervise the sanitary appliances and regulations and to give careful instruc-

tion and explanations. He held practical instruction classes with the mothers, lecturing on diet and cooking, cleanliness, the way to take body temperatures, and how to look at the children's throats.

This experiment was entirely successful, though the doctor lived in Paris. There was not a single death in three years. There were one or two cases of scarlet fever and diphtheria, that were promptly and effectively isolated. This experiment was not philanthropic, but financial, the employer realizing that he had better value in work from healthy hands.[a]

A few factories now use or permit the use of a reader to read to their employees, where the manual nature of their work is such as not to be hindered by listening to a story. Others use a piano and have their employees march in and out to music. The curious physiological relations between rhythm and work are now being observed by physiologists. Laboratory tests with ergometers seem to show that more work can be done under the stimulus of rhythm. Soldiers and sailors have for ages made use of music and rhythm, and it would not be beyond the range of possibility if the factory system should in some cases find more use for it than at present.[b]

Unconsciously, business corporations have also made changes which tend to improve the sanitary conditions under which their employees work. In a large telephone exchange in Chicago the perfect working of the apparatus was much hampered by dust, so that insulation was seriously affected. To obviate this condition an expensive system was put into operation, by which the air was washed and pumped into the rooms under ideal conditions. What the company aimed at was the perfect health of its apparatus, but it gained in addition a decided improvement in the health of its employees.[c]

Another similar organization, the New England Telephone and Telegraph Company, at Cambridge, Mass., ventilated its offices during the winter of 1907–8 with unusual care, with the result that the number of days of work lost by its 60 female employees was cut in half.

The need of industrial efficiency is driving business men to demand temperance or even total abstinance among their employees. This is one of the most powerful motives to-day working against the abuse of alcohol. In the South employers and the public see that negroes who drink are inefficient and dangerous. Railway officers and the traveling public realize that public safety requires sober locomotive engineers and firemen. Even drinking among sailors is being discountenanced. Doctor Grenfell, the missionary among the Labrador fishermen, says: "Why don't I want to see liquor used at sea? Because when I go down for a watch below, I want to feel that the man at the wheel sees only one light when there is only one light to see."

Among semipublic institutions with power to exercise prodigious influence in improving the public health are the life insurance companies. Just as fire insurance companies make efforts to decrease the risk of fire, so life insurance companies might well join in public health movements to effect a reduction in the human death rate.

While the financial motive is sordid, it should be utilized because of its tremendous power. The insurance companies to-day represent

[a] Hubert Higgins, "Humaniculture," New York (Stokes), 1906, pp. 209–211.
[b] See Karl Bücher, "Arbeit and Rythmus," Leipzig, 1902.
[c] See Outlook, May 26, 1906.

an invested capital of over $3,000,000,000. An actuary recently remarked to me, in connection with this subject, that they could without feeling it contribute great sums annually to the preservation of public health. When insurance companies were established, the old dictum that human vitality followed a fixed law served probably to exclude the idea of preventing death claims rather than paying for them. Now that we are learning the preventability of disease, the time must come when insurance companies will take an active part in the fight. Even a single company would probably make a good investment if it sought to educate its own "risks." But a far more effective method would be a combination of all companies to improve public health through the enactment of public legislation—by Congress, state legislatures, municipal governments, and in numberless other ways.[a]

Among some official agencies meant to promote the social welfare are two recent commissions appointed by the President—the Homes Commission, of 1907, appointed for the purpose of studying the housing conditions in the District of Columbia, and the Commission on Country Life, appointed to study the daily life of the farmer. Farm sanitation will be especially considered.

Finally, there is a public yet voluntary agent in the progress of hygiene that must not be overlooked, namely, the modern periodical. Not only do the daily papers devote much attention to questions of health and hygienic reform, but the popular magazines have taken up the fight against disease, and are educating the popular mind, more surely than is realized, concerning the natural and normal way of life. It is necessary to add, however, that these same periodicals often nullify the benefits derivable from their reading matter by printing the most harmful of patent medicine, quack, drug, and alcoholic advertisements. Public odium should attach to newspapers and magazines that advertise hurtful nostrums. It is impossible to estimate the harm wrought to the public health each year through such advertising.[b]

The daily papers are especially culpable in this regard, but weeklies and monthlies are not wholly clear of the taint. When a newspaper's advertising space is once bought by quacks or nostrum sellers, its news columns become closed at once to matter considered objectionable by such advertisers. Frequently news items reflecting directly or indirectly on quackery are suppressed. Notable examples of publications that have taken strong ground against such advertising are Collier's Weekly, The Outlook, The Ladies' Home Journal, and a few—a very few—daily papers.

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[a] Since the above was written the Committee of One Hundred on National Health has urged this matter before the Association of Life Insurance Presidents, which body has appointed a committee to draw up plans. Also the Metropolitan Life Insurance Company has organized a bureau of cooperation and information to aid in distributing information to policy holders of the "industrial" class.

[b] For further discussion of this topic see a pamphlet by Samuel H. Adams on "The Great American Fraud," reprinted by the American Medical Association from a series originally appearing in Collier's Weekly, and "A Century's Criminal Alliance between Quacks and Some Newspapers," by Champe S. Andrews, Publications of the Committee of One Hundred, 1907.

CHAPTER IX.—*Conservation through personal hygiene.*

SECTION 1.—*Its importance.*

Following public and semipublic hygiene, we arrive at what is in many respects the most important subject of all, personal hygiene. It is quite true that the individual is often at the mercy of unclean streets, bad drainage, impure water and food, and other shortcomings of public and semipublic hygiene. On the other hand, his own personal interest is necessary in order to form the public opinion which alone can result in effective public and semipublic hygiene, while that interest is still more necessary to make such hygiene apply directly to his own person. Clean streets are of use only as they make the air breathed purer, but they are of little avail to the household which does not ventilate its rooms or which keeps them in a state of filth. The milk supply of a city may be ideal, but all the pains to make it so will be set at naught if the individual consumer allows the milk to be contaminated after it is delivered. The labeling of foods and drugs will not prevent self-poisoning through alcohol, nor will the elimination of preservatives from foodstuffs and the enforcement of sanitation in their manufacture be of avail if in their preparation for the table they are subjected to disease and dirt. Thus at every point of hygienic progress, there must be individual cooperation with public efforts.

When, contrariwise, health organizations and officials are inefficient, the individual may, in spite of these difficulties, often maintain good health. In New York a woman who was the occupant of a tenement overcame tuberculosis by sitting daily on her fire escape. The air was not the best, but it was much better than indoors. Similar results have been obtained by workmen in Brockton shoe factories, who, in spite of insanitary working places, and without cessation of work, conquered tuberculosis by sleeping on the roofs of their houses at night.

Observation shows that many, possibly most, of the world's most vital men and women have virtually made over their constitutions from weakness to strength. Cornaro, the famous nonogenarian, Kant, and Humboldt are cases typical in different fields of achievement. Cornaro, a Venetian nobleman born about the middle of the fifteenth century and given up to die at the age of 37, forswore all unhygienic habits and began to live "the temperate life," his abstemiousness applying especially to food. His age at death is variously estimated, but he lived to be at least 97. When over 90 he wrote a treatise on longevity, laying down as the chief rules of a normal life, care in eating and drinking, and the avoidance of melancholy and passion.[a]

Centenarians have usually been persistent followers of some rule or rules of rational hygiene, even though unconsciously.[b]

Metchnikoff points out[c] that part of the supposed inheritance of longevity may not be inheritance, but similarity of environment, and that it very frequently happens that husband and wife both live to be

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[a] See L. Cornaro, "The Art of Living Long" (English translation, Wm. F. Butler, Milwaukee), 1903.

[b] Metchnikoff, "The Prolongation of Life," p. 141.

[c] Ibid., p. 86.

over 100. This could scarcely happen by accident, but must be due to similar habits or environment.

Humboldt confessed to a fellow-student that in the first years of his childhood his tutors were doubtful whether even ordinary powers of intelligence would ever be developed in him, and that it was only in the advanced part of his boyhood that he began to show any evidence of mental vigor. As a boy he suffered from debility which not infrequently produced great prostration.[a]

Of recent examples may be mentioned a young physician who was given up to die of tuberculosis five years ago, but who to-day can run 25 miles without a rest; and Horace Fletcher, who in his 46th year was rejected for life insurance, but who later not only obtained his insurance, but proved his powers of endurance by cycling 190 miles on his 50th birthday.

And not only can weakness, if recognized early enough, be turned into strength, but strength, however great, may be dissipated in an incredibly short time.

Personal hygiene means the strengthening of our defenses against disease. Public hygiene seeks to destroy the germs before they reach our bodily defenses. These two branches of hygiene are simply the two forms of warfare, defensive and offensive. Both are of transcendent importance, but the defensive warfare is more within our power. We always have our defending garrison, the white blood corpuscles, to deliver us from our enemies.[b]

SECTION 2—*Branches of personal hygiene.*

Personal hygiene comprises hygiene of environment (air, soil, dwelling, clothing); hygiene of nutrition; and hygiene of activity.

Man is more dependent upon the atmosphere than upon any other environmental factor. His body is bathed in air and his most vital function, respiration, depends upon it. Deprived of air, he will shortly suffocate. If the air is confined and impure, his health will be affected. Ideal air should first of all be pure—i. e., free from injurious bacteria, from dust, smoke, and noxious gases. It should also conform to certain standard conditions of humidity and temperature. In this field lie the sciences of climatology and meteorology. Man learned long ago how to make himself almost independent of climatic and atmospheric conditions by the use of dwellings and clothing. These contrivances, however, while protecting him from the elements, have brought evils of their own. The great scourge of tuberculosis, for instance, is principally an indoor disease.

Intimately related to the appropriation, through the lungs, of oxygen from the atmosphere is the ingestion of food and drink through the alimentary canal. Normal health conditions demand in the case of ingested materials, as in the case of respired air, the greatest possible purity, freedom from injurious bacteria, and the absence of substances hurtful mechanically or chemically.

Finally, the ideal conditions of health require perfect balance of work, play, and sleep.

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[a] "Life of Alexander von Humboldt," by Lowenberg Ave-Lallewort and Dore, translated by Jane and Caroline Lassell, New York (Lee & Shepard), 1873, Vol. I, pp. 30–32.

[b] Metchnikoff, "The New Hygiene," p. 14.

While absolutely perfect conditions in these three branches of hygiene are unobtainable, hygienic progress consists in approaching these ideals as closely as possible.

The rules of personal hygiene are expressed in standard medical works on the subject. There is nothing novel in the brief résumé which follows. The radical changes in habits of living which are now being advocated and to some extent practiced imply nothing new. They have, for the most part, long been commonplaces of the medical profession. The knowledge is old. It is the application which is new. Medical men have long been telling their patients to get plenty of fresh air and to masticate their food. But until recently their advice has fallen on deaf ears.

SECTION 3—*The hygiene of environment.*

Air hygiene deals first of all with ventilation.[a] The importance of properly ventilating houses is so great that to secure this end the architecture of houses will have to be changed. The worst historical instances of bad ventilation are the imprisonment and virtual suffocation of 146 persons in the "Black Hole" of Calcutta and the confinement of 300 men in an underground room after the battle of Austerlitz. The evils of overcrowding come mainly from exhaled air and from the effluvia thrown off by the skin. Not only does overcrowding bring bad air, but it also increases the opportunity for infection.

The air in our houses has impurities of its own. Oil and gas vitiate it. Electric lights are hygienic in this respect. Air is never quite free from dust impurities. Aitkin estimates that country air carries 2,000 dust particles per cubic centimeter, city air 3,000,000, and inhabited rooms 30,000,000.

In a clean hospital ward, when air was agitated by dry sweeping, the number of colonies of bacteria collected on a given exposure rose from 26 to 532, showing the effect of ordinary broom sweeping. The broom is now being replaced by the carpet sweeper, and the carpet sweeper in turn by the vacuum cleaner. Each step represents progress in the elimination of dust. The removable rug is in this regard an improvement over the carpet.

Air may even be poisoned by the chemicals contained in wall paper or in the plaster of a brick and mortar dwelling.

The one place where the individual has more control over the air he breathes than anywhere else is his sleeping room. He may be powerless to control the air in his place of work, or even in the rooms where he lives during the day. But, except where he shares a bedroom with others who are averse to modern ideas of ventilation, he can largely control the air supply during sleep, and this means during one-third of his whole time. He can open wide his windows and in many cases arrange actually to sleep out of doors. The growing practice of sleeping out of doors is one of the most significant signs of the times. Only those who have tried it realize the benefits. The air supply in public places would be under the control of individuals, if organized in protest; and our churches, theaters, public halls, railway coaches, and railway sleepers would be properly ventilated if the

[a] See Richards and Woodman, "Air, Water, and Food," New York (Wiley), 1904; also Carpenter, "Heating and Ventilating Buildings," New York (Wiley), 1905; Sykes, "Public Health and Housing" London (King), 1901, 216 pp.

public demanded improvement. Such a "score card" as Prof. John R. Commons has devised for measuring the relation of housing conditions to an ideal standard might well be used in measuring the health utility of public places.

The windows of living and work rooms may be opened in summer and somewhat in winter, provided a window board is used, to deflect the cold air upward from the sill. It then does not form a cold stratum on the floor, but mixes evenly with the air of the room. This simple device would go far to solve the question of winter shut-ins and their ailments. In many cities sleeping balconies are not uncommon among the dwelling houses.

The many benefits from a pure air supply are only beginning to be realized. For instance, as long as "the outdoor life" is lived a cold is almost impossible. Army officers have noted that as long as the men are on the march and sleep outdoors they hardly ever have colds, but that they become troubled with these as soon as they get indoors. Franklin, a century ago, knew these facts, though few of the present generation are acquainted with them. He believed "that people who live in the forest, in open barns, or with open windows, do not catch cold, and that the disease called 'a cold' is generally caused by impure air, lack of exercise, or from overeating." He came to the conclusion that influenzas and colds are contagious—a doctrine which, a century and a half later, was proved, through the advance of bacteriological science, to be sound. The following sentence exhibits remarkable insight, considering the state of medical art at that time: "I have long been satisfied from observation that besides the general colds now termed 'influenzas' (which may possibly spread by contagion, as well as by a particular quality of the air), people often catch cold from one another when shut up together in close rooms and coaches, and when sitting near and conversing so as to breathe in each other's transpiration; the disorder being in a certain state." In the light of present knowledge what a cautious and exact statement is that.[a]

John Muir, the geologist and naturalist, says that he finds home the most dangerous place he can visit.

> As long as I camp out in the mountains without tents or blankets I get along very well, but the minute I get into a house and have a warm bed and begin to live on fine food, I get into a draft, and the first thing I know I am coughing and sneezing and threatened with pneumonia, and am altogether miserable.

Atmospheric evils come from improper ventilation, and affect either the respiratory organs of the body or the skin. It has been supposed until recently that the presence of carbon dioxid gas in vitiated air was the chief evil caused by such air. Impure air will affect the lungs harmfully, but not till the amount of carbon dioxid contained is very large. Guinea pigs, on which the effects of bad air were observed, were not seriously affected by the carbon dioxid till it amounted to 14 per cent of the volume of the air. Flügge and others have found that the evil of close atmospheres is largely a result of elevated temperature, humidity, and absence of air currents. Tests were made on men who sat in impure air, but breathed pure air through tubes, and they presented all the symptoms usually resulting from bad ventilation.

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[a] From "Benjamin Franklin as Printer and Philosopher," address of President Charles W. Eliot before American Philosophical Association, April 20, 1906.

Air baths have been shown to be as important for bodily health as water baths. For this purpose porous clothing should be worn and no more of it than is needful. Impervious cloth and rubber are probably injurious as clothing. Loosely woven worsteds, or linen and cotton mesh are best adapted to let the air play on the skin. Clothing to be hygienic, should not constrict the body. Tight shoes, and especially tight corsets, are distinctly injurious, and the injury to mothers from the latter may be felt by the next generation. Another insanitary feature in clothes is the trailing skirt, which drags indoors the sputum of consumptives and germ-laden dirt from the sidewalk.

Closely connected with air and ventilation is light. The benefit of sunshine in killing germs and improving bodily vigor in every way is too well known to need more than mention. Tuberculosis and other germs thrive only in dark, damp, ill-ventilated places.

Light has its most important bearing on the human health through the sense of sight. Its relation to eye strain has been discussed elsewhere. Headaches, backaches, indigestion, hysteria, and epilepsy are often aided by glasses.

SECTION 4.—*The hygiene of nutrition.*

A primary necessity for hygienic living is good drinking water. The modern man of means insists upon good water, and, as a result, the traveling public is now able to get first-class water in cars, hotels, and other public places. The improvement was brought about by the appreciation by the consumer of the danger of drinking impure water. It is the consumer who has it in his power to bring about the necessary reforms in public hygiene. When he really values hygienic environment producers will supply it. Professor Sumner has told us that persons in the middle ages sometimes drank out of their castle moats, which contained sewage. Even in New York to-day the roof tanks are sometimes used as baths or laundries; and they accumulate dust and flies very rapidly. Only a few years ago the aldermen in a prominent western town laughed out of court a physician who called their attention to dangers which were real, but which they believed imaginary, from a polluted water supply.

The scientific study of diet has only just begun and few authoritative results can yet be stated. To avoid a lengthy review of controversial literature it seems best to pass the subject over rapidly, referring the reader for further information to some of the principal books on the subject.

We have already seen the surprising improvement in endurance which followed the adoption of thorough mastication in place of the ordinary food bolting. Mr. Gladstone used to be noted for his care in slowly masticating his food, and latterly Mr. Horace Fletcher has aroused the interest of the public in the subject in Europe and America.[a] He has also stimulated a large number of physiologists to study the subject of mastication, the protein ration, and their relation to strength and endurance.

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[a] See Horace Fletcher, "The A, B–Z of our Own Nutrition," New York (Stokes), 1903; Dr. Hubert Higgins, "Humaniculture," New York (Stokes), 1906; and Irving Fisher, "The Effect of Diet on Endurance," publications of Yale University, Transactions of the Connecticut Academy of Arts and Sciences, 1907.

A great deal has been written as to what foods are best. There exist various dietetic cults, such as vegetarians and fruitarians, raw-food advocates, etc. The question of what foods are ideally best is too large a one to be entered upon here. The evidence seems to point to a general conclusion that no hard-and-fast rule of exclusion is advisable, and that the value of different foods varies with the individual and with his activity, locality, physical condition, etc. His own instinct, restored and educated by avoiding the pernicious habit of food bolting, may be made a truer guide than the wisest physician or physiologist. The same rule applies to the amount of food to be eaten, as well as to the proportions of protein, fat, carbohydrates,[a] and mineral salts. Food bolting often leads to overeating.

It should be noted that the conclusions of Chittenden and others are not in favor of a vegetarian régime, but of a low protein régime, whether vegetarian, lacto-vegetarian, or with flesh foods in moderation. The main point is moderation of the foods highest in protein, such as the whites of eggs and meats (especially lean meats).

It would seem that the safest course for the average man is to follow the appetite, simply guiding it toward a low protein diet by thorough mastication, and by giving the benefit of the doubt to foods low in protein. A reduction in the use of meat will increase, and probably cheapen, our national food supply. The raising of cattle requires much more land than the raising of cereals, fruits, nuts, and vegetables yielding the same amount of food value. As this will be a most important economic problem during the next hundred years, the question of the character of our food supply should be most carefully considered in the study of the conservation of natural resources. It is interesting to note, in this connection, that during the last century the consumption of flesh foods in the United States has considerably decreased.[b]

The subject of auto-intoxication as a consequence of excessive protein has already been mentioned.[c] To avoid auto-intoxication the putrefactive bacteria may be neutralized by lactic bacilli, such as are contained in sour milk. Another preventive is regular attention to thorough evacuation.

Diseased foods are, needless to say, dangerous. Oysters are often planted in waters polluted with sewage, with the result that epidemics of typhoid fever have been traced to their consumption.

The housewife must be the guardian of the family in these respects, and in the cooking, preparation, and arranging of food generally. These now constitute "domestic science," which is justly winning recognition as one of the most potent of all hygienic agencies. When

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[a] For a short method of measuring these magnitudes, see Irving Fisher, "A New Method of Indicating Food Values," American Journal of Physiology, Vol. XV, No. V, April 2, 1906; and for its practical application see "A Graphic Method in Practical Dietetics," Journal American Medical Association, Vol. XLVIII, April 20, 1907. See also, "Statistics of Diet in Consumptive Sanatoria," American Journal Medical Sciences, September, 1906.

[b] See G. K. Holmes, "Meat Supply and Surplus," Bureau of Statistics, Department of Agriculture, Bulletin 55, 1907, p. 47. Mr. Holmes finds that the consumption of dressed meat per capita in the United States decreased between 1840 and 1900, 40 per cent, and between 1890 and 1900, 25 per cent.

[c] Supra, Chap. V. See also Herter's "Common Infection of the Digestive Tract."

the kitchen becomes a scientifically conducted laboratory we shal have the basis of a sound "home economics."

SECTION 5.—*Drug habits.*

It would scarcely be an exaggeration to say that the first rule of hygiene is to avoid poisons. Poisons may be generated within us or ingested from without.

Drug habits take numerous forms, and they are more prevalent than most persons realize. The commonest form of intoxication is alcoholic.[a] It is interesting to observe the change which has come about in the attitude of scientists toward alcohol. From having enjoyed a high place in materia medica, it is in danger of being completely discredited.[b] So far as its habitual use is concerned the only question which remains in debate is whether in minute quantities it may be innocuous or even beneficial. In any except minute quantities it has been shown to be injurious.

It lowers the resistance of the white corpuscles, which are the natural defenders of the body. Although the phagocytes belong to the most resistant elements of our body, yet it is not safe to count on their insensibility toward poisons. It is well known that persons who indulge too freely in alcohol show far less resistance to infectious diseases than abstemious individuals.[c]

Here is the gravest indictment that may be brought against the abuse of alcohol. It is not, however, the only one. The relation of drinking to insanity,[d] peripheral neuritis, Bright's disease, cirrhosis of the liver, inflammation of the stomach, arteriosclerosis (a most common cause of apoplexy),[e] tuberculosis;[f] to crime in all its forms,[g] and to all the possibilities incident to the hereditary transmission of a weakened organism[h] has been pointed out. If personal hygiene is a duty, it is the duty of every man to recognize the danger from alcohol to himself and to his progeny yet unborn. Instead of copying the habits of others, he may consider the responsibility of causing others to copy his.

A subcommittee of the Committee of Fifty for the investigation of the liquor problem published in 1899 a volume on the economic

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[a] For a discussion of the physiological effects of alcohol, see Physiological Aspects of the Liquor Problem, investigations made under the direction of W. O. Atwater, John S. Billings, H. P. Bowditch, R. H. Chittenden, and W. H. Welch, subcommittee of the Committee of Fifty; New York, Houghton & Mifflin, 1903, 2 vols.; and The Liquor Problem, a Summary of Investigations Conducted by the Committee of Fifty, 1893-1903, by John S. Billings, Charles W. Eliot, Henry W. Farnam, Jacob L. Greene, and Francis G. Peabody, 1905.

[b] The rôle of alcohol as a predisposing cause of disease has already been noted. It has long been known that drunkards have a very slim chance of recovery when attacked by pneumonia, and it is noted also that the mortality among moderate drinkers is higher than among total abstainers. This fact has long been known to life-insurance companies as holding good for many diseases other than pneumonia. Osler: Modern Medicine, Vol. II, p. 628.

[c] Metchnikoff: The New Hygiene, p. 25.

[d] See "Twenty-sixth Annual Report of Massachusetts Bureau of Labor," 1905.

[e] Ditman, loc. cit., p. 47.

[f] See John Huber, M. D., "Predisposition to tuberculosis," The Medical News, December 26, 1903, p. 12. Also reports of Phipps Institute, Philadelphia.

[g] See Boies's various works, the "Reports of the Committee of Fifty," and Report of the Massachusetts Bureau of Labor Statistics, 1895.

[h] See Henry Smith Williams, M. D., "Alcohol and the Individual," McClure's Magazine, October, 1908, pp. 704–712.

aspects of the problem. The investigation covered a period of about three years and was carried on under the general direction of Prof. Henry W. Farnam, of Yale University. The general conclusions of this investigation were that of the poverty which came under the notice of the charity organization societies about 25 per cent could be traced directly or indirectly to the use of liquor; of the poverty found in almshouses, about 37 per cent. In the investigation of crime, the conclusion was reached that liquor was a first cause in 31 per cent of the criminals studied, and that it entered in as a cause, directly or indirectly, in 50 per cent.

The investigation made by the Massachusetts bureau of statistics of labor in 1895 indicated the following percentages due to alcoholism:

	Per cent.
Crime	84.41
Pauperism	48
Insanity	35

Several English life-insurance companies—the Sceptre, the United Kingdom, and General Provident and others—have found by their statistics, running over forty years, that abstainers have a death rate about 23 per cent lower than nonabstainers.[a] Since the figures of the Mutual Life Insurance Company of New York[b] give the same advantage to American abstainers (23 per cent lower death rate), it seems fair to take the available computations of the English life insurance companies as a basis for estimating the saving of life that would result in the United States if individuals should decide to give up the use of alcohol. It should be remembered, however, that the favorable figure of total abstainers is partly due to the fact that as a class they practice personal hygiene in all its forms.

A basis for computing the sickness that might be saved by total abstinence is furnished by comparison between the sick rates of abstaining and nonabstaining societies, made by Mr. H. Dillon Gouge, public actuary of South Australia, in 1892. He found that the average weeks of sickness in three societies of abstainers was 1.248; in three societies of nonabstainers the average weeks of sickness was 2.317 (lacking only one-sixth of being twice as much).

Absinthe in France has become almost as clearly a cause of national degeneration as opium in China. Fortunately for our own country there exists here a more determined effort than in most, if not all other nations, to be rid of alcoholism. The movement has been formidable enough to arouse anxiety among those whose capital is invested in breweries, distilleries, and saloons. The movement reaches its maximum momentum in the west and the south of the United States. It is significant of the rapid change of sentiment in regard to the liquor question that physiologists, physicians, educators, and publicists are now becoming so thoroughly impressed with the importance of suppressing the evils of alcohol.

The younger members of the Kaiser's family in Germany are opposed to the German habits in regard to the use of alcohol, and the son of the Kaiser chose for his university one where there was less

[a] Letter from Miss C. F. Stoddard, secretary of the Scientific Temperance Federation.

[b] "Effect of Total Abstinence on the Death Rate," by Joel G. Van Cise, actuary of the Equitable Life Assurance Company of the United States.

drinking than at other universities. President Eliot, of Harvard University, has recently taken a strong position against the use of alcohol, even "in moderation."

Another common, though less injurious, source of self-poisoning is tobacco, which is known to stunt the growth of the young, to lead to sluggishness and weakened hearts ("tobacco hearts"), and to cause dyspepsia and neurasthenia.

Snuff taking has almost disappeared as a habit in this country. Chewing tobacco is still common, though no longer defended by hygienists. "Inhaling" is more common, though also usually condemned on grounds of health. Smoking shows no signs, as yet, of decreasing. In moderation it may not be injurious. There are no definite proofs on either side. But smokers are seldom moderate.

Doctor Seaver, of the Yale Gymnasium, found that of the 187 men in the class of 1891, Yale College, those not using tobacco during the college course had gained over the users of tobacco in weight 32 per cent, in height 29 per cent, in growth of chest 19 per cent, and in lung capacity 66 per cent.[a]

Similar returns for the Amherst graduating class of 1891 showed a gain by the nonusers of tobacco of 24 per cent in weight, of 37 per cent in height, and of 42 per cent in growth of chest. In lung capacity the tobacco users had lost 2 cubic inches of air space, while the nonusers had gained 6⅓ cubic inches.

The somewhat injurious effect of tea, coffee, and condiments, though less than many other evils, should be included in any list of the imperfections in respect to hygiene of existing habits of life.

Section 6.—*Activity hygiene.*

Only a generation ago there were scarcely any gymnasia in this country, but to-day the importance of regular exercise and bathing is recognized by everyone. This is far from saying, however, that this important method of conserving our vital resources has more than begun to be exploited.

First, the bath for the well-to-do, and, latterly, the public baths for the poor, have given all an opportunity to obtain the cleansing and healing agency of water. And in recent years the application of baths has become a science.[b]

Baths may be used as social agents. Judge Ben. B. Lindsey, of the Denver juvenile court, insists that every child must take a bath before appearing in the court room. Neutral baths, i. e., baths regu-

[a] Doctor Anderson, of the Yale Gymnasium, finds similar results. He also points out a statistical pitfall into which some investigators have fallen. This is the common statistical fallacy of selection. There are two great groups of college students, roughly distinguished as athletes and scholarship men. (See Doctor Sargent, "Physique of scholars, athletes, and the average student," Popular Science Monthly, September, 1908.) Smoking is more common in the former group. They are not athletes because they smoke, but smoke because they are athletes. The raw figures of smokers and nonsmokers usually show that the smokers have better physical development, but if we compare the smoking athletes with the nonsmoking athletes and the smoking scholarship men with the nonsmoking scholarship men the results are quite different. For similar statistical fallacies, due to failure to subgroup properly, see Mayo-Smith, "Statistics and Sociology," Macmillan, 1895.

[b] See J. H. Kellogg, M. D., "Rational Hydrotherapy," Philadelphia, 1904.

ıted to the temperature of the body, have been found valuable in elaxing the nerves of the body, and even in the treatment of mental isease.

As to exercise, a healthy organism must call into play every function daily, both mental and physical. One of the evils of the division f labor which civilization has brought is that the sedentary worker oes not have enough physical exercise, but too much mental exercise, hile the situation is just the opposite in the case of the workingman. A well-known physical director, now nearly 50 years old, writes me ıat he has this year taken up systematic physical training, which e has neglected for several years because of pressure of work. As result his weight has risen, his chest and arm girths have increased, hile his waist girth has decreased, and he is conscious of decided nprovement in memory and in sleep. This instance is cited as an xample of the physical development possible in a man of middle ge.

In its bearing on exercise, the growth of modern athletics and its ffects on the physical ideals of men and women is to be welcomed. he revival of the Olympian games and the spread of popular parcipation in such outdoor sports as golf, tennis, boating, and horseıck riding have all had their share in building up a new health eal. Thus we are getting away from the mediæval idea of mortiıation of the flesh and approaching more closely the Greek concepon of a beautiful body as the covering for a beautiful soul. The reeks lifted their sports to a higher level than ours by surrounding em with imagination and making them a training in æsthetics as ell as in physical excellence.[a] The American idea is at present too osely connected with mere winning, and not enough with development. In the past the physical athlete has been too much associated ith the pugilist, and has been looked down upon as having merely ute strength. The intellectual type, on the other hand, has been ntent wholly to neglect bodily development.

In the last three years considerable evidence has accumulated to ow that the sitting posture of the sedentary man tends sooner or ter to produce nervous prostration, and that the ordinary chair vites to this effect by producing a bent attitude, both in the forward rection and in the shoulders. The effect of the former is to tax e splanchnic nerves and congest the portal circulation. The lanchnic area, which is enormous, is a sort of overflow tank for the ood. If the muscles of this area are allowed to relax through imoper position in standing or sitting, the result is the stagnation the blood in the abdomen, and this in turn results in a vicious rcle of evil effects. Since much of our life is spent in chairs, this ct is of no small importance. Improperly made school chairs and ıhygienic habits of sitting in them may start off millions of young ves with round shoulders, curved spines, and the later effects of rtal congestion.

Exercise of mind does not simply mean exercise of intellect. The notions and the will are equally a part of a well-developed healthy an. Late in life Darwin had occasion to lament the fact that his notional capacity had become cramped because he had exercised

[a] See G. L. Dickinson: "The Greek View of Life," New York (McClure, illips), 1906, pp. 131–134.

his mind in his own branch of work to the exclusion of other things. Whatever our ideas of theology or religion are, it is true that we all ought to have a spiritual sense. Some men lack this spiritual sense and are incapable of understanding the spiritual experience of others. "For toil without purposeful and occupied leisure is unfilled purpose, a process arrested midway."[a] Worry and fear are unhealthy. Hope, courage, enjoyment, and an optimistic attitude generally are healthy.[b]

The ordinary workingman works two or three hours too much every day. Nearly every man overworks himself, takes insufficient rest and recreation, and worst of all, cuts off his normal portion of sleep. Fatigue ought to be "avoided like poison," because, physiologically, it is really poison. Worry, fear, and anger also produce poisons harmful to the human body. This is suggested at least by the effect upon a nursing infant of violent paroxysms of anger, or periods of intense fear or anxiety on the part of its mother. The intense exhaustion which follows such paroxysms is another case in point.

An animal lives a much more healthy life than the average man, because an animal follows instinct, while a man to a large extent endeavors to substitute for his instincts rules which are very often false. One of the instincts constantly disregarded by man is that which finds its expression in fatigue. The ordinary man working for some one else is compelled to toil beyond the fatigue limit; and, on the other hand, if a man is in business for himself, he does the same thing of his own will. Although no one knows what sleep is, it serves, according to the best theory, to eliminate poisons and to rebuild tissue. With rest is closely associated recreation. Play practices the power of a child's mind, while contest among children develops self-control.[c] Similarly, adults are rested by play or recreation, their minds and bodies are relaxed, while their contests of mimic warfare develop their powers of will and effort.

Section 7.—*Sex hygiene.*

One element in personal hygiene concerns the sex relation. This can not be treated under other heads, for the sex relation is so purely a personal and individual one. From its normal utilization there is little to fear, but from the effects of illegitimate sexual practices the world suffers enormous yearly losses. It is hardly possible to have promiscuous sex relations out of wedlock without contracting one or the other of the serious venereal diseases. The best authorities report that "every prostitute is diseased some of the time and some prostitutes are diseased all of the time."

One disease, syphilis, infects the blood and therewith all parts of the body. For months after infection with this disease the indi-

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[a] Simon N. Patten: "The New Basis of Civilization," New York (Macmillan) 1907, p. 158.

[b] Du Bois: "The Psychic Treatment of Nervous Disorders," New York, 1905, 465 pp. Saleeby: "Worry, the Disease of the Age," New York (Stokes), 1907. Sidis: "The Psychology of Suggestion," New York (Appleton), 1899, 386 pp. Schofield: "The Force of Mind, or the Mental Factor in Medicine," London (Churchill), 1902, 309 pp.

[c] See President G. Stanley Hall: "Play and Dancing for Adolescents," Independent, reprinted in "Mind and Body," Vol. XIV, 1907, pp. 43–48.

vidual may communicate it by a kiss as well as by cohabitation; and articles moistened by his secretions—towels, drinking glasses, pipes, etc.—may also convey the infection. While under proper treatment the disease is not always dangerous to life in the earlier years, yet the possibilities of transmitting the contagion should forbid marriage for at least three years.

The most serious results of syphilis, some authorities say, may appear years after its acquisition, when the individual has been lulled into a false sense of security by long freedom from its manifestations and considers himself cured. Many cases are practically incurable. Some are fatal in spite of treatment. It may attack any organ of the body. Among the many diseases to which it may lead are apoplexy, paralysis, insanity, and locomotor ataxia; and these often appear after the man has acquired a family that is dependent upon him for support.

The leading insurance companies refuse to insure the life of a syphilitic person for four or five years after the disease was contracted, and then only upon special terms, for their records prove that syphilis shortens life.

That the syphilitic parent may transmit the disease to his offspring is common knowledge. Some of his children are destroyed by the inherited disease before birth; others are born to a brief and sickly span of life; others attain maturity, seriously handicapped in the race of life by a burden of ill health, incapacity, and misery produced by the inherited taint, while still others escape these evil effects.[a]

Forel, in Die Sexuelle Frage, shows that even Weissmann does not deny the possibility of poisoning the germ cell and so transmitting some "acquired characteristics," as in alcoholism and venereal poisoning. One of the saddest facts in both cases is that the parent may escape and the children reap the results in insanity, tendency to consumption, and prostitution.

Another disease—

Gonorrhea, while usually cured without apparent loss of health, has always serious possibilities; it kills about 1 in 200; it impairs the sexual power and fertility of a much larger number; it often produces urethral strictures, which later may cause loss of life.[a]

The persistence of gonorrhea in the deeper parts long after it is outwardly cured leads to the unsuspected communication of the disease to women with whom the individual may cohabit. Much of the surgery performed upon women has been rendered necessary by gonorrhea contracted from the husband. Should she while infected with this disease give birth to a child, the baby's eyes may be attacked by the infection, sometimes with immediate loss of sight. Probably 25 per cent [b] of the blindness of children is thus caused.

Dr. Prince A. Morrow says:

This social danger comes from frequent introductions of these diseases into marriage. The frequency of marital contamination does not admit of exact mathematical expression, as both social sentiment and professional ethics unite to cover up and conceal it. Possibly 10 per cent of men who marry infect their wives with venereal disease.

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[a] Circular No. 2, "Self-protection," Chicago Society of Social Hygiene, pp. 7–8.

[b] "The average of a great many statistics shows that one-fourth of all blind persons owe their affliction to the effects of ophthalmia of the new born." Chas. H. May, M. D., ophthalmic and aural surgeon, New York, Transactions of American Societies of Sanitary and Moral Prophylaxis, Vol. II, 1908.

The report of the Committee of Seven (New York) shows that in private practice nearly 30 per cent of venereally infected women were contaminated by their husbands. The report of the Committee on Sanitary and Moral Prophylaxis (Baltimore) shows that nearly 40 per cent of the infections in women seen in private practice were communicated in married life. "My own observations at the New York Hospital, extending over a period of several years, would indicate that fully 70 per cent of all women who came there for treatment of syphilis were respectable married women who had been infected by their husbands." [a]

Observation shows that gonorrhea is markedly intensified in virulence and danger to the woman in fulfilling the functions for which marriage was instituted. Pregnancy and childbearing open the way for germs. One of the most constant effects of gonorrhea in women is permanent and irremediable sterility. Fifty per cent of gonorrheally infected women become absolutely sterile, and a still larger percentage sterile after the first child is born (one-child sterility). Noeggerath found in 81 gonorrheal women 49 entirely sterile. In 80 sterile marriages Kehrer found 45 caused by inflammatory changes of gonorrheal origin. It is estimated that the husband is directly responsible for 20 to 25 per cent of sterility from his inability to procreate as the result of gonorrhea. In addition the husband, though not sterile himself, may infect his wife, rendering her sterile. The disease is ultimately responsible for about 70 to 75 per cent of all sterility in married life, which is not of choice, but of incapacity. Lier-Ascher's careful statistics place this proportion at 71.2 per cent. These figures relate to absolute sterility. The chief social danger of gonorrhea as a depopulating factor is the creation of secondary sterility, or what has been expressively termed "one-child sterility." The large percentage of marriages in which one child represents the total fecundity of the family justifies the conclusion that this sterility is in many cases not of choice, but of procreative capacity extinguished by gonorrhea.

In addition, the inflammation set up in the maternal organs may render the mother a permanent invalid or compel her to submit to a mutilating operation to save her life.

Gynecologists furnish statistical evidence showing that 80 per cent of the deaths due to inflammatory diseases peculiar to women [b] and about 70 per cent [c] of all the work done by specialists for diseases of women is caused by gonorrhea.

In addition to the effect of a low protein diet on endurance, already discussed, and on general health, its relation to the sexual life should be mentioned. Experiments on this subject seem to show that excessive meat eating and excessive protein intake tend to irritate the sexual organs and to produce abnormal sexual desire just as they do

[a] Morrow, Social Diseases and Marriage, Philadelphia (Lea), 1904.

[b] In report of special committee of the American Medical Association, 1901, Hunniston says: "Ninety per cent of inflammatory troubles of maternal organs are attributable to gonorrhea." Price says: "That in over 1,000 operations for pelvic trouble 95 per cent were attributable to this infection." Another authority gives a percentage of 75.

[c] Address of Doctor Cleveland, president of American Gynecological Society, at National Congress of American Physicians and Surgeons, Washington, 1907.

a desire for alcoholic stimulation. This fact is of importance in preventing secret vice among the young.

Thanks to the efforts of a few farsighted men like Dr. Prince A. Morrow, Prof. C. R. Henderson, and Mr. Edward Bok, these subjects are being given some of the publicity they deserve. Reticence on these subjects is justified only so far as it makes for youthful innocence. But ignorance is not innocence; on the contrary it is the surest road to guilt.

SECTION 8.—*Personal hygiene in general.*

Personal hygiene is only beginning to be generally exploited. Most persons leave their health to be attended to by physicians and health officers, just as many people leave their religion in the hands of a priest or clergyman. So far as practiced at all, personal hygiene has been confined chiefly to invalids and athletes. Even by them it is usually practiced to tide over an illness or to prepare for a contest. But it is manifest destiny that a wise economy of vitality will sooner or later be practiced. Waste of vital resources is as irrational as waste of natural resources. Neither is inexhaustible and both must be conserved. Thoughtlessness and ignorance are the reasons for the appalling waste of both now going on. Even people who do not defiantly abuse their strength by definite excesses are liable to waste it gradually. Slightly unhygienic habits grow, and their effects are doubtless cumulative. It is well known that even a so-called "ventilated house," if lived in long enough without sufficient outdoor life, may induce tuberculosis. This must be through the repetition of an infinitesimal injury produced through each respiration eighteen times a minute for twenty-four hours a day for half a lifetime.

So with the use of food preservatives. Food manufacturers have laid much emphasis on the fact that preservatives are "harmless" because used in small quantities, but Doctor Wiley has raised the question whether even very small quantities of these preservatives, if used continuously for a sufficient length of time, are not injurious. The same applies to the repetition of preservatives in a large number of different foods. If only one particular food contained a preservative, the effect would be relatively negligible; but as one food after another has become adulterated, the human stomach is made the daily receptacle of many times the "harmless" amount in any one particular food. The obstacles to hygiene which have accumulated with civilization are almost as numerous and as small as the barnacles which impede a ship. To remove them is in large part to "return to nature." Many of the inventions of which civilization boasts have had an unhygienic side. The invention of houses has made it possible for mankind to spread all over the globe, but it is responsible for tuberculosis, especially after glass was devised, which while letting in the light keeps out the air. The invention of cooking and preparing foods has widened the variety of man's diet, but has led to the decay of his teeth.[a] The invention of the alphabet and printing

[a] See Ottofy, "The Teeth of the Igorots," Dental Cosmos, July, 1908, where it is shown, statistically speaking, that the teeth of Americans are "ten times as bad as those of the Igorots," while the civilized Filipinos have teeth as bad as those of Americans.

has made possible the accumulation of knowledge, but it has produced eye strain with all its attendant evils. The invention of chairs has added to human convenience, but has led to spinal curvature and abdominal congestion. The device of a division of labor has added to wealth, but has destroyed the normal balance of mental and physical work, recreation, and rest. Similar fault may be found with clothing, especially corsets, shoes, and hats, and with numerous other contrivances. Yet it would be foolish, even if it were possible, to attempt to "return to nature" in the sense of abolishing civilization. We must not go backward, but forward. The cure for eye strain is not in disregarding the invention of reading, but in introducing the invention of glasses. The cure for tuberculosis is not in the destruction of houses, but in devices for ventilation. It is a little knowledge that is dangerous. Civilization can, with fuller knowledge, bring its own cure and make the "kingdom of man" far larger, even in respect to hygienic conditions, than "nature" people can ever dream of.

Unhygienic customs and fashions are exceedingly slow to yield, but they do yield in the end. It should be the part of intelligent men to lead in hygienic reform, not by intolerant and impatient abuse of their fellow-men, but by the quiet force of example. The intolerant and impatient reformer does incalculable harm, for he takes no account of that subtle perversity of human nature which resents his interference. Equally harmful is the man who seeks only to imitate the crowd, who condones the vices of his time and country.

But we must always bear in mind what has been called the "psychology of the crowd." Tarde, Le Bon, Baldwin, Ross, and others have shown that society is largely ruled by customs which grow out of imitation. In order that any social custom shall be changed, initiative is necessary. The upper classes should take the lead, for any reform will spread many times more quickly when the initiative comes from above than when it comes from below. Western civilization has made its marvelously rapid progress in Japan for the simple reason that the Mikado approved, and marvelously slow progress in China for the simple reason that the Empress disapproved.

We find the same principle at work in the progress of medicine. Hydrotherapy originated with a peasant and required three centuries to come into vogue. The use of sour milk, on the other hand, has been advocated only during the last two or three years, but the initiative came from Metchnikoff, one of the foremost of medical scientists. The consequence is that the so-called "sour-milk craze" has already led to great industries and affected the business of groceries, soda-water fountains, and even liquor saloons.

The change constituting hygienic reform will be brought about most rapidly by the influences on the young. If children in their homes and schools are given proper models for imitation, the public opinion which they will form may make a revolution in a single generation. Anyone who realizes the almost resistless force of the principle of imitation, especially when applied to children, will receive a new sense of the responsibility he takes in setting an example to the young. There are three classes in particular on whom the responsibility is heavy—teachers, physicians, and parents. If they wish the child to be free from the cigarette habit, they must sacrifice the cigar and pipe habit, even though it be true that cigars and pipes are not injurious to adults. They may believe this, but the children will not. The same

principle applies to other and more serious infractions of the laws of health. It is probably through the love of the next generation, rather than through any selfish care for the present, that men and women now living will take the most pains to secure the best results in bringing about the change in living conditions for which every hygienist hopes.

CHAPTER X.—*Are hygienic measures eugenic?*

SECTION 1.—*Prolongation of weak lives.*

We have discussed two factors which cooperate to produce vitality, namely, heredity and hygiene; and two corresponding methods of improving vitality, namely, by utilizing a possible science of eugenics on the one hand and by utilizing the existing science of hygiene on the other. The question now arises, Are these two methods in conflict with each other? It is charged that hygiene prolongs the lives of unfit and defective classes. We have already seen that in Indiana, institutional care of the insane has prolonged the average insane lifetime by some eight years. Referring to the insane, Dr. Charles Dana says:

> For twenty-five years the explanation of this increase in statistics of insanity has been that more cases were observed and more victims kept in institutions than formerly; and this is still the explanation. It is my opinion, however, that the increase is a real one, and it is one to be expected not only from the strenuousness of modern life and increase of city population, but also, because more feeble children are nursed to maturity and more invalid adolescents are kept alive to propagate weakly constitutions or to fall victims themselves to alienation, the period of life susceptible to insanity is longer.
>
> A fourth of the cases of insanity is due to so-called "moral causes:" Emotional strain, shocks, and vicious indulgences. But moral causes are not sufficient to cause insanity if the individual has a strong constitution. Insanity is increased in part, then, because we are saving too many lives by the careful regulations of our health boards. Hence, those who are working so enthusiastically and nobly and successfully in preventing disease achieve results which carry serious responsibilities for the State.[a]

It is true that we prolong the lives of the insane and defective classes, and that they thus make a greater burden on society. We should see to it that certain of these classes are not permitted to propagate their kind. This point has been explained in Chapter VI.

It is further claimed that infant mortality is but the operation of natural selection and should not be interfered with if we are to keep up the vital power of the race. Preventive medicine has certainly prolonged the lives of infants or, at any rate, of children in general.[b] But has this weakened the race? It is pointed out that the mortality later in life has not decreased, and that in some cases it has even tended to increase. But this fact can be explained in either of two ways. One is on the hypothesis of the extension of the lives of weak

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[a] "Psychiatry in its relation to the other sciences," by Charles L. Dana, M. D., before the section on psychiatry at the International Congress of Arts and Science, at St. Louis, September, 1904. See also Janus in Modern Life, by W. M. Flinders Petri, New York (Putnam), 1907.

[b] See Edwin Graham, "Infant mortality," Journal American Medical Association, September 26, 1908; also Edward B. Phelps, "Statistical study of infant mortality," Quarterly Publications American Statistical Association, September, 1908. Mr. Phelps shows that infant mortality has declined less than is commonly believed, and that its apparent decline is often due to inaccurate and misleading statistics.

infants. The other is on the hypothesis of the comparative neglect of hygiene among adults. It is surprising that this latter alternative has not been given due consideration.

Every detail of infant life has latterly been made the subject of special study, and every mother of common intelligence has tried to learn and to apply the results of that study. The times of the baby's meals, the quantity of its feeding, the modification and sterilization of cow's milk, the hours of sleep, the ventilation of sleeping rooms, and other innumerable details are now attended to with scrupulous care. The change in these respects, even within the memory of most persons now living, is striking. The children have reaped the reward. But no corresponding change has taken place in the habits of the adult population. Many families buy one grade of milk for the babies, and another cheaper grade for the rest of the family. This they regard as "economy." Parents require their children to keep regular and suitable hours for sleep, but "owl it" themselves. They will keep their children out of doors, and send them into the country, but subject themselves to the dust, smoke, and close air of the workroom and places of business. They will not allow their children to use alcohol or tobacco, or even tea or coffee, much less opium, chloral, or other habit-forming drugs, but they take these themselves as a matter of course. They are now insisting on playgrounds for children, but their own amusements are sought in the unhygienic theater, or maybe in the saloon or immoral resort. The child is protected on all sides, with the result that he sometimes lives almost an ideal animal life, with its due proportion of amusement, exercise, rest, and sleep. The parents themselves are tied down to drudgery, overwork, worry, and long hours. The difference, when we reflect upon it, is startling. We make hygiene paramount for our children; for ourselves we neglect it totally, partly from the idea of sacrificing ourselves for the sake of our children, partly from necessity, real or imagined, and partly from the thraldom of habit already formed. With such a contrast between the recent improvement of hygiene in childhood and the lack of improvement in middle life, one need not wonder that the mortality of one period has improved and that of the other has not. We do not need to invoke the aid of the theory that weak lives have been more prolonged than strong lives. The moral is that hygiene should not stop in childhood. It is natural and proper, however, that the first attempt to apply hygienic knowledge should begin with children. It is through children that new ideas usually make their way into custom. "You can't teach an old dog new tricks." Grown persons have habits already formed, and when once a habit is formed it is difficult to change it.

Habits of living among adults have even grown worse in some respects. Observing practitioners comment on the increasing nervous tension in modern life. The rush of the railway train, the telephone, the elevator are at once an outgrowth and an excitant of this increased tension. They are life's pace makers, and the pace is ever quickened. The health officer of New York City attributes to this severer strain the increase of heart and nervous diseases. It would be interesting to know the relative prevalence of adult diseases under conditions of reposeful and exciting surroundings and occupations, but I know of no investigation on this phase of the subject.

While this report was being written the recent figures from Great Britain came to hand. They show that the tendency of the death rates among the later ages to increase seems to have given place to a slightly opposite tendency. The expectation of life at ages 40, 60, and 80 during the decade of 1891–1900 has a little more than held its own as compared with the previous decade.

SECTION 2.—*Children's diseases impair both fit and unfit.*

Another point needs emphasis. When it is said that the lives of weak infants are prolonged it is commonly overlooked that the same causes also prolong the lives of the strong, and, reversely, that unhygienic conditions which tend to exterminate the weak tend also to shorten the lives of the strong. Bad hygiene is merely a common handicap for all classes. The burden of proof is upon those who claim that it has a differential effect and increases the process of weeding out the unfit. This weeding-out process goes on whether there is a great or a small obstruction to overcome. Bad air and children's epidemics are the common environment of all. While this must produce a greater mortality, it remains to be shown that it would be more selective.

That a high infant mortality does not tend to lengthen life, but rather to stunt all life, would seem to be indicated by the evidence, so far as it can be interpreted. Russia, for instance, has a high infant mortality. If the statistics are to be trusted, it is 70 per cent greater than in the United States; yet Moscow and St. Petersburg have a general mortality rate which greatly exceeds that of similar cities in this country.

It may be that the more unfavorable the struggle for existence the more rapidly will natural selection result in improved vitality. But even if this were true, it would not imply that in a more favorable environment selection would cease. And it may not be true. It may be that adversity, if too severe, will crush and injure the survivor as well as eliminate the unfit. We do not look for the best trees on the bleak mountain top, but in the genial valley. As we go up the struggle for existence increases, until even the sturdiest fail to thrive above the "timber line."

> The farmer who tries to improve his stock does not select hardships. Cold and starvation are now negligible quantities in the great ranches, and the breeds that were notable for ability to withstand them give way to varieties that may be adapted to neither emergency.[a]

Venereal diseases, hook-worm disease, malaria, and many other maladies shorten and weaken life, whether of weak or strong. Referring to the racial degeneration probably caused by malaria on the sturdy Greek, Maj. Ronald Ross said, in an address before the Oxford Medical Society, November 29, 1906:[b]

> Now what must be the effect of this ubiquitous and everlasting incubus of disease on the people of modern Greece? Remember that the malady is essentially one of infancy among the native population. Infecting the child one or two years after birth, it persecutes him until puberty with a long succession of febrile attacks. * * * Imagine the effect it would produce upon our own

[a] Simon N. Patten, The New Basis of Civilization, New York (Macmillan), 1907.

[b] This quotation is from Dr. L. O. Howard's report to the Conservation Commission on "Economic loss to the people of the United States through insects that carry disease."

children here in Britain. * * * What would be the effect upon our population, especially our rural population—upon their numbers and upon the health and vigor of the survivor? It must be enormous in Greece. People often seem to think that such a plague strengthens a race by killing off the weaker individuals; but this view rests upon the unproven assumption that it is really the weaker children which can not survive. On the contrary, experience seems to show that it is the stronger blood which suffers most—the fair, northern blood which nature attempts constantly to pour into the southern lands.[a] If this be true, the effect of malaria will be constantly to resist the invigorating influx which nature has provided; and there are many facts in the history of India, Italy, and Africa which could be brought forward in support of this hypothesis. * * * In prehistoric times Greece was certainly peopled by successive waves of Aryan invaders from the north. * * * That race reached its climax of development at the time of Pericles. * * * Suddenly, however, a blight fell over all. Was it due to internecine conflict or to foreign conquest? Scarcely, for history shows that war burns and ravages, but does not annihilate. Thebes was thrice destroyed, but thrice rebuilt. Or was it due to some cause, entering furtively and gradually sapping away the energies of the race by attacking the rural population, by slaying the newborn infant, by seizing the rising generation, and especially by killing out the fair-haired descendant of the original settlers, leaving behind chiefly the more immunized and darker children of their captives, won by the sword from Asia and Africa? * * * I can not imagine Lake Kopais, in its present highly malarious condition, to have been thickly peopled by a vigorous race; nor, on looking at those wonderful figured tombstones at Athens, can I imagine that the healthy and powerful people represented upon them could have ever passed through the anæmic and "splenomegalous" infancy (to coin a word) caused by widespread malaria. Well, I venture only to suggest the hypothesis, and must leave it to scholars for confirmation or rejection. Of one thing I am confident—that causes such as malaria, dysentery, and intestinal entozoa must have modified history to a much greater extent than we conceive.

Evolution in human society is a wonderfully complex thing. Survival of the races has long been dependent on a long period of protection of children by parents, and may in future even depend on protection of other kinds.[b]

Section 3.—*Fitness is relative to environment.*

Whether or not degeneration is actually going on is a question for which the data are insufficient for us to form an intelligent generalization. That there are very strong forces working in that direction can not be questioned, but there are also very strong forces working in the opposite direction. In discussing degeneration, one point must be borne in mind which has often been forgotten by writers on the subject. Man's fitness to live is relative to the environment in which he is to live. If muscular strength decreases, it is not a sign of degeneration, provided muscular strength is no longer needed. One does not speak of hothouse grapes as degenerates. They doubtless lack the hardy characteristics of wild grapes, but these characteristics are not needed in a hothouse.

If it should prove true that in some directions humanitarian impulses betray us into favoring the survival of the unfit and their perpetuation in the next generation, such shortsighted kindness must be checked. But all the dangers of perpetuating vital weaknesses can be avoided if proper health ideals are maintained. For when such

[a] Physicians maintain that some diseases, especially typhoid fever and pneumonia, are more apt to attack the strong than the weak.

[b] See Prince Kuropatkin, "Mutual Aid a factor in Evolution," New York (McClure-Phillips), 1902.

health ideals become a national possession fewer weak infants will be born into the world. This will come about in three ways: First, marriage and "sterilization" laws will reduce the number of marriages of degenerates. Secondly, parents will be more careful of transmitting disease or weakness to their offspring. There is strong reason to believe that inheritance depends largely upon the physical condition of both parents at the time of conception. If at such a time either parent, or both parents, are in a state of intoxication or sufferers from venereal disease, this lack of hygiene on their part will affect the heredity of the offspring. Immorality, which practically means lack of sex hygiene, never strengthened a race; on the contrary it has been the most potent cause of race extinction (of the Hawaiians, Indians, negroes, and others).[a] Thirdly, the influence of higher ideals of health and vitality will tend both to restore the attraction of a strong and beautiful physique to its rightful place among the various attractions which lead to marriage, and to lessen the allurements of such extraneous attractions as wealth.

[a] See F. L. Hoffman, "Race Traits and Tendencies of the American Negro," Publication of American Economic Association, Ch. VII, August, 1896.

Part IV.—RESULTS OF CONSERVING LIFE.

Chapter XI.—*Prolongation of life.*

Section 1.—*Life is lengthening.*

We have already seen evidence of the possibility of prolonging life: In Europe the life span is double what it is in India. The death rate of Dublin is over twice that of Amsterdam, and three times that of rural Michigan. Again, making every allowance for inaccuracies of old records, we have strong reason to believe that life is twice as long as three or four centuries ago, and modern accurate records show that it is to-day increasing more rapidly than ever. The rate at which this lengthening proceeds per century is shown in the following table, based on Chapter I.

Rate of lengthening life (in years, per century).

Country.	Periods.	Males.	Females.
England	1838–1854 to 1871–1881, or 30 years	5	9
Do	1871–1881 to 1891–1900, or 20 years	14	16
France	1817–1831 to 1898–1903, or 76 years	10	11
Prussia	1867–1877 to 1891–1900, or 23 years	25	29
Denmark	1835–1844 to 1895–1900, or 57 years	13	15
Sweden	1816–1840 to 1891–1900, or 67 years	17	15
United States:			
Massachusetts.	1789 to 1855, or 66 years	7	
Do	1855 to 1893–1897, or 40 years	14	
India	1881 to 1901, or 20 years	0	

From this table we observe:

First. That the rate of progress is extremely variable in different countries. It is perhaps no accident that the maximum rate obtains in Prussia, which is probably the most progressive country in the discovery and application of scientific medicine. If progress continues for a century at merely the present rate, human life in Prussia will be twenty-five to twenty-nine years longer than at present. The average rate of improvement for all the countries, excepting India, is about fifteen years per century.

Second. It is noticeable that in practically all cases the improvement is more among females than males. This is one expression of the progress which womankind is now making in all lands.

Third. This table, as well as the estimate of Professor Finkelnburg already quoted, shows that not only is the average duration of human life increasing, but that the rate of increase is also increasing. The estimate of Finkelnburg that the lengthening of life during the interval between the sixteenth century and the end of the eighteenth century was from eighteen or twenty years to a little over thirty years shows a rate of increase of about four years per century. During

he following century he estimated that the life span increased from a little over thirty to thirty-eight or forty years, or about nine years per century. In the table we see that in England the length of life was increasing in the middle of the nineteenth century at a rate of from five to nine years per century, while during the last quarter it was increasing at from fourteen to sixteen years per century. In Massachusetts the imperfect data indicate that life lengthened in the first half of the eighteenth century at the rate of about seven years a century. The indication for the last part of the nineteenth century is that it increased at the rate of fourteen years per century.

We may briefly summarize chronologically the general rate of increase as follows:

Lengthening of human life per century.

	Years.
During seventeenth and eighteenth centuries	4
During first three quarters of the nineteenth century	9
Present rate in Massachusetts	14
Present rate in Europe	17
Present rate in Prussia	27

SECTION 2.—*Table showing further practicable prolongation.*

It would be surprising if the future should not witness a further lengthening of human life, and at an increasing rate. Of course there is a limit to the further increase of human life, but there is good reason to believe that the limit is still far off.

The following table[a] shows that at least fourteen years could be added to human life by the partial elimination of preventable diseases according to the stated ratios of preventability. This is equivalent to a reduction in the death rate of about 25 per cent. The table is based on the causes of death given in the census volume for mortality statistics for 1906. These causes are arranged according to the average, or rather median,[b] age at death from the disease. This median age is given in the second column. The order in this column shows at a glance the successive onslaught of, or rather fatality from, the various causes of death. The table shows the successive bombardments of disease to which human life is subject.

The third column gives the average lost "expectation of life;"[c] that is, the expectation cut off by each particular cause of death.

The fourth column represents the percentage which the deaths from each particular cause bear to the total number of deaths in 1906 in the registration area. It shows the relative importance of the different causes of death in the present death rate, but has no reference to the age at death.

The fifth column contains an estimate, made by physicians, of the ratio of preventability of deaths from each cause named.

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[a] For detailed statement in regard to the construction of this table, see appendix to this chapter.

[b] By the "median" age at death is meant the age such that one-half of the deaths occur earlier and one-half later than this age. The "median" is a species of average, but differs from the ordinary arithmetical average. It has the great advantage of ease of computation.

[c] The "expectation" is taken from the figures of Abbott for Massachusetts, 1893–1897, and is the average of expectation of males and females. See Report State Board of Health for Massachusetts, 1898.

The items in the sixth column are found by multiplying together those in the fourth and fifth columns, and express the percentage which the preventable deaths from each cause named bears to the total number of deaths from all causes.

The seventh and last column gives the figures for which the table is constructed, namely, the amount of prolongation of life which would come about through preventing deaths according to the ratios of preventability in column 5. When it is said that a death is preventable, it is not, of course, meant that the person saved from it will never die, but merely that his death is postponed. The term "postponable" would avoid a great deal of confusion on the subject.

The principle on which the last column is constructed is simply the principle of averages. The column shows the prolongation of life which would be caused by postponing the "postponable" deaths by the amounts indicated in column 3. To illustrate this principle, suppose ten magnitudes to be averaged arithmetically, and that their average is thirty. To fix our ideas, we may suppose these ten magnitudes to be represented by ten lines drawn on a sheet of paper. It is evident that if one of these ten lines is prolonged the average of the ten will be thereby increased by exactly one-tenth of the prolongation of that one line.

Possible prolongation of life.

(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	[b](4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i. e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
1. Premature birth	1	50	2	40	0.8	0.4
2. Congenital malformation of heart (cyanosis)	1	50	.55	0	.....	.....
3. Congenital malformations other than of heart	1	50	.3	0	.....	.....
4. Congenital debility	1	50	2.3	40	.92	.46
5. Hydrocephalus	1	50	.1	0	.....	.....
6. Venereal diseases	1	50	.3	70	.21	.11
7. Diarrhea and enteritis	1	50	7.74	60	4.64	2.32
8. Measles	1	50	.8	40	.32	.16
9. Acute bronchitis	1	50	1.1	30	.33	.17
10. Broncho-pneumonia	1	50	2.4	50	1.2	.6
11. Whooping cough	1	50	.9	40	.36	.18
12. Croup	2	54	.3	75	.22	.12
13. Meningitis	2	54	1.6	70	1.12	.6
14. Diseases of larynx other than laryngitis	3	54	.07	40	.03	.02
15. Laryngitis	3	54	.06	40	.02	.01
16. Diphtheria	3	54	1.4	70	.98	.53
17. Scarlet fever	3	54	.5	50	.25	.14
18. Diseases of lymphatics	5	54	.01	20	.002	.001
19. Tonsilitis	8	52	.05	45	.02	.01
20. Tetanus	8	52	.19	80	.15	.08
21. Tuberculosis other than of lungs	23	40	.17	75	.13	.05
22. Abscess	24	39	.08	60	.05	.02
23. Appendicitis	24	39	.7	50	.35	.14
24. Typhoid fever	26	38	2	85	1.7	.65
25. Puerperal convulsions	28	[a]37	.2	30	.06	.02

[a] "Expectation" for females.

[b] As to some inaccuracies in this column, see Appendix to this chapter, section 4.

Possible prolongation of life—Continued.

(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	(4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i.e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
Puerperal septicemia	28	a 37	0.4	85	0.34	0.13
Other causes incident to childbirth	31	a 35	.36	50	.18	.06
Diseases of tubes	31	a 35	.1	65	.06	.02
Peritonitis	31	34	.5	55	.28	.1
Smallpox	32	34	.01	75	.01	.003
Tuberculosis of lungs	33	33	9.9	75	7.42	2.46
Violence	34	32	7.5	35	2.7	.86
Malarial fever	34	32	.2	80	.16	.05
Septicemia	34	32	.3	40	.12	.04
Epilepsy	35	32	.29	0	.....	.....
General, ill defined, and unknown causes (including "heart failure," "dropsy," and "convulsions")	35	31	9.2	30	2.75	.85
Erysipelas	37	30	.3	60	.18	.05
Pneumonia (lobar and unqualified)	37	30	7	45	3.15	.94
Acute nephritis	39	29	.6	30	.18	.05
Pleurisy	42	27	.27	55	.15	.04
Acute yellow atrophy of liver	42	27	.02	0	.....	.....
Obstruction of intestines	43	26	.6	25	.15	.04
Alcoholism	44	25	.4	85	.34	.09
Hemorrhage of lungs	45	25	.1	80	.08	.02
Diseases of thyroid body	46	24	.02	10	.002	.0005
Ovarian tumor	46	a 25	.07	0	.....	.....
Uterine tumor	46	a 25	.1	60	.06	.02
Rheumatism	47	23	.5	10	.05	.01
Gangrene of lungs	48	23	.03	0	.....	.....
Anemia, leukemia	48	23	.4	50	.2	.05
Chronic poisonings	48	23	.05	70	.03	.007
Congestion of lungs	49	22	.4	50	.2	.04
Ulcer of stomach	49	22	.2	50	.1	.02
Carbuncle	49	22	.03	50	.015	.003
Pericarditis	52	20	.1	10	.01	.002
Cancer of female genital organs	52	a 21	.6	0	.....	.....
Dysentery	52	20	.5	80	.4	.08
Gastritis	53	19	.65	50	.32	.06
Cholera nostras	53	19	.09	50	.05	.01
Cirrhosis of liver	54	19	.9	60	.54	.1
General paralysis of insane	55	18	.3	75	.22	.04
Hydatid tumors of liver	55	18	.002	75	.002	.0003
Endocarditis	56	17	.8	25	.2	.03
Locomotor ataxia	56	17	.17	35	.06	.01
Diseases of veins	57	17	.04	40	.02	.003
Cancer of breast	58	a 17	.4	0	.....	.....
Diabetes	58	16	.8	10	.08	.01
Biliary calculi	58	16	.17	40	.07	.01
Hernia	59	16	.27	70	.19	.03
Cancer not specified	59	16	.9	0	.....	.....
Tumor	59	16	.08	0	.....	.....
Bright's disease	59	16	5.6	40	2.24	.36
Embolism and thrombosis	60	15	.26	0	.....	.....
Cancer of intestines	60	15	.5	0	.....	.....
Cancer of stomach and liver	61	14	1.7	0	.....	.....
Calculi of urinary tract	61	14	.03	10	.003	.0004
Cancer of mouth	63	13	.1	0	.....	.....
Heart disease	63	13	8.1	25	2.02	.26
Influenza	64	13	.7	50	.35	.05
Asthma and emphysema	64	13	.23	30	.07	.009
Angina pectoris	65	12	.4	25	.1	.01
Apoplexy	67	11	4.4	35	1.54	.17
Cancer of skin	70	10	.2	0	.....	.....
Chronic bronchitis	71	9	.8	30	.24	.02
Paralysis	71	9	1	50	.5	.04

a "Expectation" for females.

Possible prolongation of life—Continued.

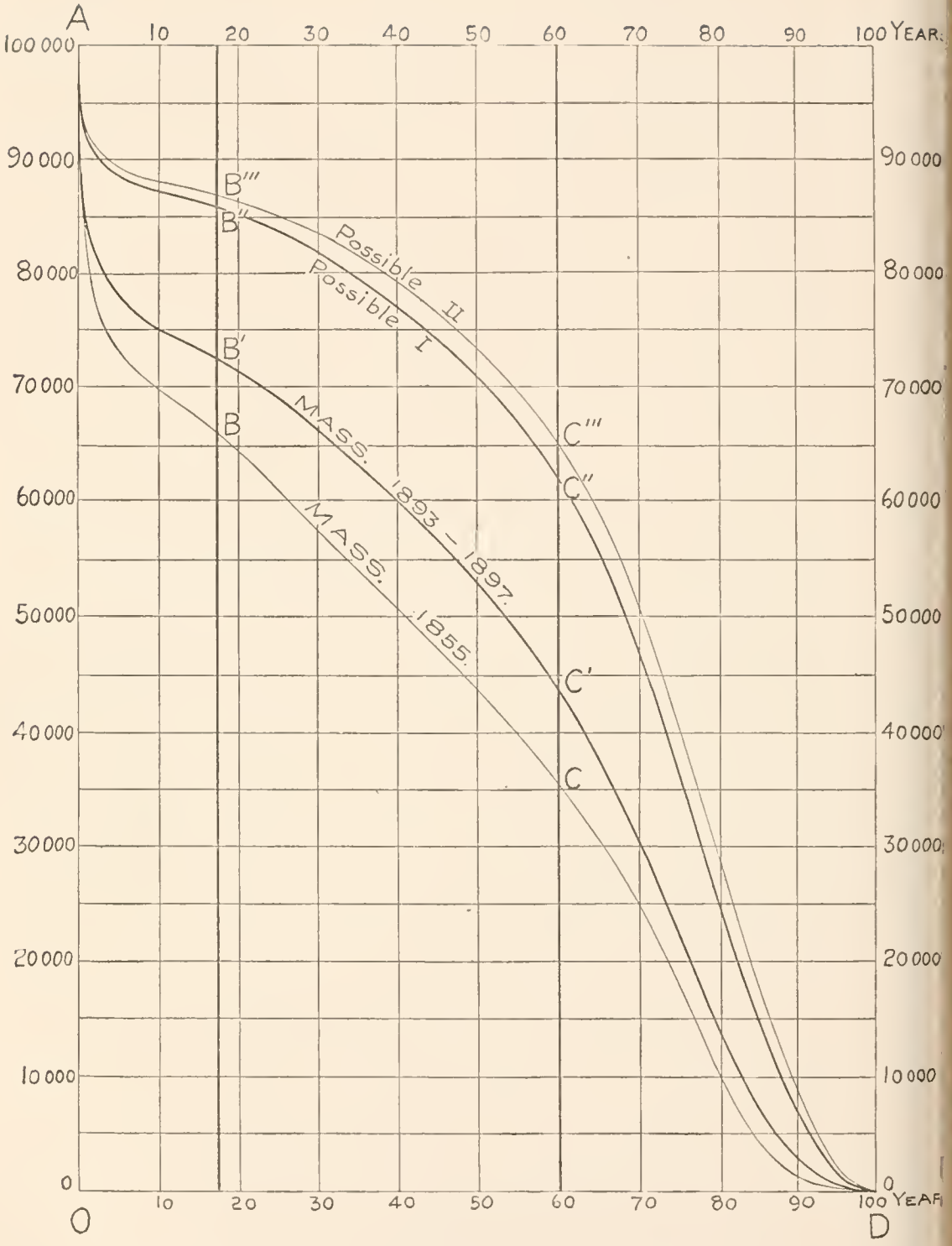
(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	(4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i. e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
86. Softening of brain	71	9	0.2	0	.....	.....
87. Diseases of arteries	73	9	0.83	10	0.08	0.00
88. Diseases of bladder	74	8	0.2	45	0.09	0.00
89. Gangrene	74	8	0.25	60	0.15	0.01
90. Old age	83	5	2	0	.....	.....
All causes	38	.....	100	42.3	[a]42.3	14.06
RÉSUMÉ.						
Diseases of infancy (having median age 1)	.....	.....	18.5	47	8.8	4.4
Diseases of childhood (having median age 2 to 8)	.....	.....	4.2	67	2.8	1.51
Diseases of middle age (having median age 23 to 49)	.....	.....	43	49	21.2	6.82
Diseases of late life (having median age 52 to 83)	.....	.....	34.3	28	9.5	1.33
All causes	.....	.....	100	42.3	42.3	14.06

[a]Although this is the ratio of general preventability of deaths under existing conditions, the death rate, i. e., deaths in relation to population, will not in the end be affected in this ratio but by only about 25 per cent. The reason for this paradox is that deaths prevented lead to a larger population (See appendix to this chapter, section 3).

Similarly, if of the ten lines three are prolonged each a certain stated amount, or are prolonged that amount on the average, the average of the whole ten will be increased by three-tenths of this amount. Consequently, if the saved lives from typhoid fever (No. 24 in the table) are, on an average, prolonged thirty-eight years, and these saved lives represent 1.7 per cent of all lives, the average life will be prolonged by 1.7 per cent of thirty-eight years. This is 0.65 or two-thirds of a year.

All the calculations are on the assumption of expectations of life such that the saved lives will die according to the present law of mortality. Consequently, if the table should be corrected by substituting in each case such an expectation of life as would conform to the improved mortality, the result would be an addition (2.1 years)[a] to the estimate of possible prolongation, which would therefore become 16.2 years. The résumé of the table shows that of the 14 years of possible prolongation of life 4.4 would be caused by reducing infant deaths under or near 1 year, 1.51 by reducing mortality from children's diseases, 6.82 from reducing the diseases of middle life, especially tuberculosis and typhoid, and only 1.33 by reducing the mortality of diseases the deaths from which usually come after 50 years of age.

[a] Best estimated graphically, as shown in appendix to this chapter.



SURVIVORSHIP CURVES, SHOWING SAFE MINIMUM IMPROVEMENT ATTAINABLE.

The table shows that seven of the 90 causes of death are responsible for over half of the shortening of life, namely, diarrhea and enteritis (No. 7), broncho-pneumonia (No. 10), meningitis (No. 13), typhoid (No. 24), tuberculosis of lungs (No. 31), violence (No. 32), and pneumonia (No. 38). These alone shorten life needlessly by more than eight years. Against these seven causes, therefore, our special efforts should be directed. Pure milk, pure water, pure air, and reasonable protection from accident are the chief means known at present. When the public makes up its mind no longer to endure impure milk, impure water, and impure air, and unreasonable dangers to life and limb, life will lengthen eight years, and probably a great deal more.

In the résumé of the table columns 4, 6, and 7 are found from the original table by simple addition. Each figure in the fifth column is found by dividing the figure in the sixth by that in the fourth.[a]

The final figure in this column, 42.3, is the same as the sum of column 6, and means that according to medical opinion 42.3 per cent of the deaths which occur under present conditions are preventable (postponable). The death rate, however, will ultimately be reduced, not in this proportion, but by about 25 per cent,[b] while the average duration of life will be increased about 33⅓ per cent.

SECTION 3.—*Diagram showing effect of prolongation at different ages.*

The whole process is best seen by means of a survivorship table, a diagram of which will be found on the next page.

We have here four curves which represent the survivors in successive years from a hypothetical and representative list of 100,000 persons born. The two of these curves which should be noted are the inner two, namely, those labeled "Mass. 1893–97" and "Possible I." The former is taken, in lieu of any better statistics, as representing the existing law of mortality in the United States. The latter shows what the law of mortality would be if the ratios of preventability given in the preceding table were put in force. The curve Possible I is constructed on the supposition that all the deaths prevented or postponed subsequently occur according to the present law of mortality; that is, that expressed in the curve Mass. 1893–97.

The two remaining, or outer, curves are given merely for comparison. The lowest, marked "Mass. 1855," shows the mortality which held true in Massachusetts in that year according to the estimates of the actuary, E. B. Elliott.[c] The difference between this curve and the one above shows the number of years of life actually saved to 100,000 persons subject to the mortality of 1893–1897 instead of the mortality of 1855. The upper curve (Possible II) shows the modification in Possible I on the assumption that the saved lives, instead of following the present law of mortality (Massachusetts,

[a] The result is in each case a weighted average of the individual ratios of preventability for the individual causes of death.

[b] See appendix.

[c] See Proceedings of the American Association for the Advancement of Science, 1857, pp. 61, 69; also Sixteenth Registration Report, Massachusetts, 1857, p. 204.

1893–1897), follow the law of mortality represented in the curve Possible II itself.[a]

This diagram shows at a glance what improvement has been made in mortality and at what ages, and what improvement is still possible, and at what ages, according to the preventability known to be easily possible. We see that the curve, Possible I, does not drop as far in the first year of life as the curve Mass. 1893–97. This is because of the great saving of infant lives known to be possible. The years of life which would be saved to the 100,000 persons by the new hygiene are represented by the difference in area between the new curve AB″C″D and the old curve AB′C′D, from which it was constructed by applying the ratio of preventability. This area can easily be measured by a planimeter, and is found to be 1,280,000, which, divided by the 100,000 persons, means an average addition of 12.8 years to the lifetime of each person born. This result differs somewhat from the arithmetical calculation, 14.06, given in the preceding table.[b] If the upper curve be used, which assumes that the "saved" lives die not according to the old but the new mortality, the addition becomes not 12.8 but 14.9 years, as against the 16.1 computed arithmetically. We may hereafter refer to this minimum estimate of possible increase of life as, in round numbers, 15 years. The lengthening of life would be from 45 to 60, or one-third.

The diagram also shows the saving of life which actually took place between 1855 and the period 1893–1897. The area between the curves for these two periods shows that 550,000 years were saved for a supposed group of 100,000 persons, or 5.5 per person. The whole area of the new curve AB″C″D is 5,810,000, or 58.1 years per person, which is the new average duration of life, as compared with 45.3 for 1893–97 and 39.8 years for 1855. We may divide the diagram by two vertical lines drawn at the ages 17½ and 60 in order to discover what part of the added life occurs between these ages—that is, within the working period—and what parts fall on either side. The addition of 12.8 years to the lifetime of each of 100,000 persons, or 1,280,000 years of life in all, is divided into three groups, namely, the years falling in the period of preparation, 200,000; in the working

[a] The method of constructing the curves Possible I and Possible II from the curve Mass. 1893–97 is by means of the ratios of preventability given in the résumé of the preceding table. See appendix.

[b] The discrepancy, 1.3 years, is due to the fact that in constructing the table, based on individual diseases, I was compelled to use for the percentages of deaths by ages (column 4) the percentages obtaining in the calendar year 1906; whereas the diagram is based on the idea of a stationary population, the distribution of the deaths being represented by the shape of the curve Mass. 1893–97. The diagramatic method is therefore more correct. The abnormal age distribution in 1906 results in making some of the figures in the last column of the table too large and some too small. In a general way, the figures for the earlier ages are too large and for the later ages too small, although the figures which are most too large are probably for ages 30 to 35. Consequently the greatest error in excess is for tuberculosis, which is possibly three-fourths of a year too large. No exact corrections are possible, and any systematic corrections, even inexact, would be very laborious. This would correspond to the elaborate actuarial calculations of Hayward in England and Glover in the United States. See Hayward "On the Construction of Life Tables and on Their Application, etc." Haydock and J. W. Glover, "A Study of Tuberculosis in the United States," Journal of Michigan State Medical Society, February, 1909.

period, 680,000; in the period of decline, 400,000. The following table will show the whole process:

	Preparatory period (ages 0–17½).		Working period of life (17½–60).		Period of decline (60 and beyond).		Total.	
	Years of life.	Per cent of total.	Years.	Per cent.	Years.	Per cent.	Years.	Per cent.
Mass. 1855	12.6	32	21.9	55	5.3	13	39.8	100
Mass. 1893–97	13.5	30	25.0	55	6.8	15	45.3	100
Possible I	15.4	26	31.8	55	10.9	19	58.1	100

These figures show that in 1855 the average person born lived only 12.6 years of the 17½ years in the period of preparation for life. In 1893–97 he lived 13.5 years. If modern hygiene were applied according to the ratios of the assigned preventability, the figure would then be 15.4 years actually lived out of the 17½. Of the working period of 42½ years (17½–60, the average man living under the mortality of 1855 had only about half, or 21.9 years; under the mortality of 1893–97 he had 25.0. and under the "Possible I" mortality he would have 31.8 years.

In percentage the years in the working period remain 55 per cent of the total life in all cases. This assumes that with the prolongation of life the limits of the working period remain 17½ and 60. Since the prolongation of life carries with it a postponement of the age of disability, it follows that the proportion of working life would actually increase.[a]

It will be seen in comparing the curves on the diagram that the change wrought in the character of the mortality curve by the new hygiene simply continues the change already in progress. The family resemblance between all four curves is striking.

SECTION 4.—*Fifteen years a safe minimum estimate of prolongation possible.*

The estimate of fifteen years as the possible prolongation of life is merely a minimum estimate. This will be seen from the following important considerations:

1. The estimate takes no account of future medical discoveries, which are now coming at such a rate that we have every reason to believe they will soon greatly increase the ratios of preventability. Cancer, for instance, has been put down with zero as its ratio of preventability, but the scientific world is intently seeking for methods of prevention and cure. Likewise "old age" has been assumed as unpreventable. Yet Metchnikoff maintains with reason that this is a malady which can be postponed.

2. The ratio of preventability of the above diseases takes little account of the cumulative influence of hygiene. Certain diseases late in life are now taken to be unpreventable or only slightly preventable on the assumption that people reach those ages in their present degree of more or less imperfect health. But on the assumption that personal hygiene had been practiced since birth, the vital resistance, which is always a deterrent of disease, would have been strengthened.

[a] See Dr. Edward Jarvis, "Political Economy of Health," Fifth Annual Report, Mass. Board of Health, 1874, p. 338, ff.

Professor Sedgwick tells us that evidence will be published demonstrating "Hazen's theorem," that every life saved from typhoid by better water supply means two or three persons saved from deaths from other causes. Our table shows an estimate of at least 85 per cent as the preventability of typhoid, but the coincident preventability of other diseases which this prevention of typhoid would bring about finds no place in the table. The individual estimates given for these other diseases take no account of such indirect action. Similarly, as Metchnikoff has emphasized, venereal diseases, though they seldom cause death, do shorten life, the "terminal disease" being quite different. The same is true of malaria and hook-worm disease, which predispose to tuberculosis and other terminal diseases. But in the table the ratios of preventability of tuberculosis and other diseases were constructed quite irrespective of any effect from reducing venereal diseases, malaria, and other devitalizing diseases.

In the matter of personal hygiene the cumulative influence is still more indirect, and perhaps still more powerful. It is now often remarked by insurance men that the best risks are not necessarily the best physiques, but may be the valetudinarians who practice personal hygiene.

There is a vicious circle of disease and a beneficent circle of health. The so-called "cause of death" given in death certificates is only the terminal cause. It is often merely the "last straw" of a terrible load gradually accumulated through life.

Evidently, to exploit the resources of hygiene, we need to consider a thoroughgoing change in health ideals and a consequent revolution in the conditions and habits of living. What would then happen to human longevity we can only conjecture. The possible addition to the life span might, for aught we know, be several times the fifteen years in the table.

3. The figures for the possible prolongation of life take no account of the ultimate racial effects of the new health ideals. If once a nation becomes thoroughly alive to the importance of maintaining the stamina of its citizens, this will, as we have seen, affect marriages—by putting a premium on health as one of the desiderata in a prospective husband or wife. The longevity of succeeding generations would certainly be improved—how much, it would be useless to guess.

The foregoing considerations, added to the fact that the estimates of preventability were made conservatively, will show that the addition of fifteen years is really only a first step. If clean milk will prevent infantile diarrheal diseases, if clean water will prevent deaths from typhoid and at the same time—according to Hazen's theorem—prevent two or three times as many other deaths, and if clean air will prevent tuberculosis, then it is evident that mere cleanliness in respect to these necessities will suffice to lengthen life by most if not all of the above estimate. Fifteen years is merely the "ore in sight." If we will work for it, we may get an even richer prize.

Within the past few years the knowledge of the causes of disease has become so far advanced that it is a matter of practical certainty that by the unstinted application of known methods of investigation and consequent controlling action, all epidemic disease could be abolished within a period so short as fifty years.[a]

[a] E. Ray Lankester, "The Kingdom of Man," New York (Holt), 1907, p. 36.

SECTION 5.—*Need of lengthening human life.*

If Metchnikoff's noble dream should be some day realized, the lengthening of human life would at once decrease the burden on the productive period. That period tends to remain 55 per cent of the total years lived, on the assumption that the working period remains 17½ to 60, but the upper limit tends to shift forward. In this way, both the absolute and relative length of the working period would be increased.

The further off the burden of old age is shifted, the easier it is for society or the individual to accumulate the wealth to provide for it. At present the burden of helpless old age is extremely serious, as those countries are beginning to realize which, like Denmark, Belgium, Germany, France, and recently England, have enacted laws to provide old-age pensions.

As life becomes more complex it requires a longer period of preparation. Preparation is education, and requires time. As the stock of knowledge increases, the period for acquiring it, or rather only enough of it to enable one to earn a livelihood, is constantly tending to increase. The age of leaving school and college is presumably growing greater.

It would be very much in keeping with the fitness of things if in this century biological science practically applied should shift the limit of the further end of the working period, the limit which we have assumed to be 60, to a later period of life. Human life would then be on a larger scale throughout. It would provide time for a longer and more thorough preparation and at the same time provide sufficient years of working life to repay this investment.

As Metchnikoff[a] well points out, one result of lengthening life will be a greater utilization of accumulated experience. We shall have less immaturity of judgment. The principle which leads to the choice for members of the judiciary of men of ripe years and knowledge will apply to every field of human activity, even those fields which are now preempted by young men because of the necessity of utilizing their vitality. It will lead to a sane and yet a vigorous conservatism. It will give to society a body of old yet hale men of experience, whose influence and worth can not be measured. As Metchnikoff has said:

> Old age, at present practically a useless burden on the community, will become a period of work valuable to the community. As the old man will no longer be subject to loss of memory or to intellectual weakness, he will be able to apply his great experience to the most complicated and the most delicate parts of the social life.[b]
>
> We may predict that when science occupies the preponderating place in human society that it ought to have, and when knowledge of hygiene is more advanced, human life will become much longer and the part of old people will become much more important than it is to-day.[c]

SECTION 6.—*The normal lifetime.*

What is the normal human lifetime?[d] Many estimates have been made, based on all sorts of reasoning, the figures extending from 75

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[a] Prolongation of Life, p. 329.

[b] Nature of Man, p. 295.

[c] Metchnikoff: "Prolongation of Life," pp. 226–227.

[d] On the topic of human longevity, see Metchnikoff: "The Prolongation of Life," Pt. II, Chaps. I, II. Shaler: "The Individual," New York (Appleton), 1901, Chap. III. Lankester: "Comparative Longevity," London, 1870, pp. 88–113.

to 200 years. Flourens's law, of doubtful value, that a mammal lives five times the length of its growing period, can not be applied generally. It is true, the horse full grown at 5 may live 25 years; sheep adult at less than 3 years may live 12; while elephants, which have an unusually tardy development, are reputed to have a lifetime of 2 centuries.

Haller, a distinguished Swiss physiologist of the eighteenth century, thought that man ought to live to 200 years; Buffon was of the opinion that when a man did not die from some accident or disease he would reach 90 or 100 years.[a]

In man the growth period is normally continued to some time after the twentieth year; its exact limit has not been ascertained, but from the statistics gathered by the Sanitary Commission during the civil war it seems most likely that it is not usually completed until after the thirtieth year.[b]

One method which has been suggested to ascertain the natural length of life is to suppose all diseases to be completely eliminated and those who now die of them to die of old age. The median age for death from old age is 83. Metchnikoff, however, shows the error of assuming present old age to be normal. We may conclude that the normal life exceeds 83.

There must needs be, of course, a limit to the possible prolongation of life. We find in recent times few authenticated cases of persons who have lived for a hundred years. As Young, former president of the British Actuarial Society, has shown in his interesting book[c] on centenarians, most cases of supposed centenarians are either cases of conscious or unconscious exaggeration or of error in records. For instance, the Countess of Desmond is said to have lived 130 years, owing to the confusion of two persons of the same name, one of whom lived to be 100 years old, while the other, her mother, died at 30, and their lives were combined in subsequent records. There are, however, some authenticated cases. Thus, the Norwegian Drakenberg was born in 1626 and lived until 1772, aged 146. "He was married when 111 years old, and as a widower of 130 proposed to marry again, although without success."[d]

At Portland, Oreg., Mrs. Mary L. Wood died recently at the age of 120 years and under circumstances which permitted the authentication of her case by the Oregon Historical Society. From these and from other cases which might be mentioned, we may conclude that if to-day, notwithstanding all existing chances of death, it is possible for some persons to live beyond 120, the chances in the future for a larger proportion of such persons will be materially improved. Whether this proportion could ever become the major part we have as yet no means of knowing. What is needed is study, and Metchnikoff is right in believing that the study is well worth while from every point of view.

APPENDIX TO CHAPTER XI.—*Method of computing possible prolongation of life.*

SECTION 1.—*"Expectations" at median ages as short cut to average expectations.*

The table given in Chapter XI is briefly described in the chapter itself. The following additional explanations are made in regard to the statistical method employed:

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[a] Metchnikoff, "Prolongation of Life," p. 84.

[b] Shaler, loc. cit., p. 61.

[c] T. E. Young: "Centenarians," London (C. & E. Layton), 1899.

[d] See article by Harald Westergaard, (British) Economic Journal, Vol. IX, 1899, p. 315.

The third column, giving the expectation of life which is lost or cut off by each particular cause of death, is estimated roughly by taking the expectation of life pertaining to the median age reached by those who die from the cause named. This expectation of life is taken from the Massachusetts Life Tables, 1893–1897.[a]

The method of using the median age is sufficiently exact in view of the inexact, or rather, safe, minimum estimates of preventability given in column five. A perfectly correct method would be much more laborious. Hayward's monograph on the effect on the duration of life of eliminating only one disease (tuberculosis) requires 190 pages of calculation. The true method consists in averaging arithmetically and weighting these averages according to the number dying at the various ages. Specimen computations show that the error involved by the short cut is not great.

Thus, for tuberculosis it is found that the average expectation of life lost by consumptives dying in 1906 was 32 years, whereas the expectation of life at the median age was 33 years. The former figure is a hundredfold more difficult to compute than the latter. Even the former is not strictly correct, since it applies to the deaths by ages as distributed in 1906, and not as distributed in a "stationary" population.

SECTION 2.—*Basis of estimates of preventability.*

The estimates of preventability given in column 5 need special explanation. In a few cases, these estimates are based on statistical experience.[b]

The great majority of them are based on clinical experience merely, without any exact statistics. They are thus in the nature of expert guesses. The experts in all cases are physicians. I have not entered any estimate of my own, unless item No. 36 might be so designated. This item is the residuum of deaths from unknown causes, or ill-defined causes, and is made up to a large extent of cases not properly reported in the death certificates. Inasmuch as the average preventability for all other causes in the table is over 42 per cent, it seemed safe to assign to deaths from these unknown causes a ratio of preventability of 30 per cent. But even if the preventability were entered as 0, the effect in reducing the result would be less than a year.

Those who gave to the construction of these estimates the benefit of their experience, observations, and reading were especially asked above all to be conservative. In order to avoid any possibility of exaggeration of their estimates

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[a] S. W. Abbott, M. D.: "The vital statistics of Massachusetts for 1897, from the thirtieth annual report of the state board of health of Massachusetts." The expectation is taken as the average of the expectations for males and females.

[b] In addition to the data in regard to special diseases discussed in the text, other pertinent material has been taken into account by those who made the estimates presented in the table. For instance, from smallpox in London in 1901–2 the mortality was 34.6 per cent among the unvaccinated, 20.9 per cent among those vaccinated after the disease was apparent, and 10.3 per cent where there was protective vaccination. In Gloucester in 1895–96 the mortality among the unvaccinated was 40.8 per cent and among the vaccinated 9.8 per cent. For children under 1 year the unvaccinated had a mortality of 72 per cent, while the vaccinated were not attacked. From cerebro-spinal meningitis the average mortality was 70 per cent (Holt); the mortality under serum treatment was 25 per cent (Flexner and Jobling). For typhoid fever, Koch and his assistants stamped out the disease in Trier by isolation of the infected persons and disinfection. (Osler, The Practice of Medicine, sixth edition.) This would probably be impracticable to such an extent in a city on account of the great expense involved and the difficulty of detecting the bacillus carriers. Other figures for typhoid fever are given in the text. For diphtheria in New York City in 1889–1891 we find the mortality was 37.3 per cent, while in 1902–1904 the mortality was 10.8 per cent. The board of health began to use antitoxin in 1895. These facts were furnished by Professor Blumer. Many data on preventability are given by John C. McVail in The Prevention of Infectious Diseases, New York (Macmillan), 1907. See especially pages 16–19. Doctor Stiles, of the Public Health and Marine-Hospital Service, is soon to publish figures showing the absolute preventability of hook-worm disease, a malady prevalent in the South, but not entering into the census tables. These tables do not cover the Southern States.

in the table their average was taken, and then the estimate, as entered in the table, was taken either as that average or below it. In no case was the estimate entered as above the average given. When, as was true in a large proportion of cases, the different estimates agreed fairly well, the average was employed, or rather the nearest figure ending in 0, or 5 next below the average. If the individual estimates diverged widely, an estimate was used below the average, favoring the conservative estimators rather than the optimistic. Also in cases where only a few estimates were obtainable, the estimate as entered was put below the average of those given.

In estimating the percentage of preventability for all the ninety causes of death, 18 estimators contributed. The number of estimates of preventability for each cause averaged nearly eight for each cause of death. It will be seen, therefore, that the table represents in a conservative way medical opinion as to the preventability of disease. The physicians who contributed these estimates are: Dr. Joseph M. Flint, professor of surgery, Yale Medical School; Dr. George Blumer, professor of the theory and practice of Medicine, Yale Medical School; Dr. H. L. Swain, clinical professor, Yale Medical School; Dr. Oliver T. Osborne, professor of therapeutics, Yale Medical School; Dr. J. H. Townsend, secretary of Connecticut state board of health; Dr. F. W. Wright, health officer of New Haven; Dr. Norman E. Ditman, of Columbia University; Dr. Cressy L. Wilbur, Chief of Division of Vital Statistics, Bureau of the Census; Dr. L. O. Howard, Chief of Bureau of Entomology, Department of Agriculture; Dr. William C. Woodward, chief health officer of District of Columbia; Dr. Charles V. Chapin, city health officer, Providence, R. I.; Dr. Henry B. Baker, ex-secretary Michigan state board of health, ex-president American Public Health Association; Dr. J. H. Kellogg, superintendent of the Battle Creek Sanitarium; Dr. Charles H. Castle, of Cincinnati, Ohio; Dr. Harry M. Steele, of New Haven, Conn.; Dr. L. Emmett Holt, of New York; Dr. Edwin O. Jordan, of the Memorial Institute for Infectious Diseases, Chicago, Ill.; Dr. Prince A. Morrow, president of the American Society for Sanitary and Moral Prophylaxis.

SECTION 3.—*Meaning of "preventable."*

The meaning of the word "preventable" requires some explanation.

1. It is to be noted that column 5 gives the ratio of preventability for mortality and not for morbidity. It means ratio of preventable deaths to all deaths, not to all cases of illness.

2. Since the word "preventable" implies the hypothesis of different conditions from those which actually exist, it is necessary to specify what hypothetical conditions shall be implied in the term. Doubtless tuberculosis would be over 99 per cent preventable if we should conceive as our hypothetical conditions that every individual could live on the prairies of the West, out of doors, be provided with the best of food, most congenial of tasks, and free from overwork and worry. Needless to say, the figures in the table do not imply such Utopian conditions, nor do they imply new medical discoveries. One hundred per cent of every disease might be preventable if we conceived as our hypothesis that the means of prevention are known and applied. The hypothetical condition selected for the meaning of the term "preventable" is contained in the following definition: *A "ratio of preventability" is the fraction of all deaths which would be avoided if knowledge now existing among well-informed men in the medical profession were actually applied in a reasonable way and to a reasonable extent.* The term "reasonable" is of course elastic, and will be somewhat differently interpreted by different persons, but, as in law, where "reasonable care" is often used as a proviso, it is impossible to make any more specific condition.

3. Considerable confusion exists in the minds of many people in regard to the number of deaths which might be prevented, or, as it is popularly expressed, the number of lives which might be saved. Since death is ultimately inevitable for all, no life can be saved except temporarily. It will serve to avoid confusion if "preventable" is explained as "postponable." The question arises when deaths are postponed, How long are they postponed? The answer is, They are supposed to occur according to existing rates of mortality. Thus, those saved from croup (No. 12) at age 2 will later die as do others who are living at age 2, and will therefore have the expectation of life (54 years) pertaining to that age.

4. The above explanation will serve to meet an objection which otherwise would immediately occur to the reader. If diseases of early life are prevented, the result will necessarily be an increase of the diseases in later life. For instance, if all the causes of death could be abolished except old age, there

would be a great increase in the number of deaths from old age, which, instead of constituting the 2 per cent of all deaths, which it does at present, would constitute 100 per cent.

But the fact that all lives saved will add to the later mortality is fully, and more than fully, taken into account in our calculations. When we assume that certain lives now lost at a given age might be saved, we also assume that they would not be saved again (even from the same disease), but would die off according to the old rates of mortality at successive ages. Their new lease of life would simply be the old expectation of life. As a matter of fact, lives now lost could probably be saved, not only once, but several times.

We may here explain the paradox mentioned in the text—namely, that a preventability of 42.3 per cent of deaths under present conditions does not imply that the death rate would ultimately be reduced 42.3 per cent.

The death rate would ultimately depend on conditions of the distribution of ages and diseases entirely different from those now prevailing. This will be clear if we think what would happen if the preventability expressed in the table could be immediately applied. During the ensuing year it would be found that about 42 per cent of present deaths would not occur. A consequence of this, however, would be that the persons whose lives were prolonged would die at a later period, since no death is absolutely prevented, but only postponed. Even if 100 per cent of all deaths were prevented (postponed), but the postponement were for a very short time, the effect in reducing the death rate would be extremely small. On the other hand, if only 1 per cent of the preventable deaths were postponed for a sufficiently long time, the ultimate effect would be to reduce the death rate much more than 1 per cent. After the deaths which had been postponed had reentered, a new equilibrium would be established. Under these new conditions the ratio of the deaths to the population would not be 42.3 per cent lower than at present, but only about 25 per cent. At present the average duration of life, taken from the Massachusetts table for 1893–1897, is about 45 years. The ratio of preventability in the above table would increase this life by about fifteen years, making it 60 years. The ratio of 45 to 60, showing the increase in the life span, will be the inverse of the ratio 60 to 45 in a "stationary" population, which would show the resulting reduction in the death rate. This is a reduction of 25 per cent. Thus the preventability of 42.3 per cent of deaths under present conditions and in the manner indicated in the table involves a lengthening of life of 33⅓ per cent and a reduction of the death rate, after readjustment of deaths by ages, of about 25 per cent.

SECTION 4.—*Error from abnormal age distribution of deaths in 1906.*

The table as given is constructed for deaths occurring in the calendar year 1906. Its interpretation, however, is to be made on the basis of a survivorship table. In a stationary population the age distribution of deaths in any year would be the same as in a survivorship table; but since the United States has not a stationary population, this identity holds only approximately.

The discrepancy accounts for the difference of one and three-tenths years in the prolongation of life, as calculated in the table and by means of the diagram. The latter is the more correct, as it is based on a survivorship table, or—what amounts to the same thing—on such mortality as would exist in a stationary population. The only way in which this diagram can be vitiated by the slightly abnormal age distribution of deaths in the year 1906 is as this abnormal distribution affects the average ratios of preventability used in constructing the diagram. These ratios are based on column (5) of the résumé of the table. The four figures from the table are adjusted by graphic interpolation in the usual way, so as to form a continuously varying series of figures for successive years of life. These ratios are in each case an average of the individual ratios for particular diseases, contained in the same column (5) of the larger table. The "weights" are slightly vitiated by the fact that the age distribution of deaths in 1906 is not the normal distribution of a stationary population. It is only as the "weighting" is thus affected that the diagram can be vitiated through our being forced to use the figures for 1906 instead of those for an ideal stationary population, since such figures are unobtainable. The error from this source is infinitesimal, and we may depend on the results of the diagram, 12.8 to 14.9 years, as practically free from any appreciable error due to the use of short-cut methods.

SECTION 5.—*Ratios of preventability by ages derived from ratios by diseases.*

In regard to the résumé containing the average ratios of preventability holding true during different ages, it will be observed that they are obtained indirectly, by calculating from the individual ratios of preventability for different diseases given in the table itself. Although these diseases are not absolutely limited to the times within which their median falls, there is a fairly distinct line of demarcation between the groups, especially between children's diseases and those of middle life. The table shows no disease with a median age of incidence between 8 and 23 years, and the census table of deaths for 1906 shows that a very small percentage of the total deaths occur between ages 10 and 20. Even if the diseases considered for the four epochs of life given in the résumé did extend somewhat into the regions of the adjacent epochs, the effect would not change the result appreciably and would be as likely to change it in one direction as the other. The reason is that the items of the column in the résumé for "ratio of preventability" are obtained by dividing the figures in column 6 by those in column 4, each of these two being found by adding the individual figures in the table for each age group concerned. The extension of diseases of an age group outside of that group will apply equally to both terms of the ratio, those in the fourth and sixth columns, and will not substantially affect the quotient in the fifth column.

SECTION 6.—*Allowance for weakness of prolonged lives.*

The use in column 2 of the expectations of life derived from the Massachusetts 1893–1897 life table is equivalent to the assumption that if preventable deaths were prevented the lives thus saved would proceed to die off according to the mortality of Massachusetts, 1893–1897. This assumes that since 1893–1897 there has been no improvement in the expectation of life, and that the saved lives will not share in the improvement which the table itself shows forth. The reason that a later life table than for 1893–1897 was not used is that no later life table is available. If it were, it would show larger figures in column 2 and consequently a larger total result for the possible prolongation of life than fourteen years.

The reason the "expectation" in column 3 does not take account of the effect of the improvement in mortality resulting from the table is that this improvement can not be calculated until column 3 is filled, and we prefer to use as a first approximation a conservative figure in column 3, rather than to guess at more likely figures. The conservative assumption used seems also advisable, because of the fact that in the 42.3 per cent of persons in the life table who would be saved from death and given a new lease of life there would be suffered a greater mortality than that of the average persons that now pass that age in safety, for—on the principle of the survival of the fittest—it is intrinsically probable that those who now die at any age are weaker than those who do not.

How much allowance should be made for this factor of differential mortality it is impossible to say with certainty. But in another paper[a] I have dealt with the same question applied to tuberculosis. Taking the figures of Dr. Lawrason Brown, giving the mortality experience among the apparently cured cases of tuberculosis discharged from the Adirondack Cottage Sanitarium, and making certain allowances, it seems that if tuberculosis were prevented its present victims would have more than three-fourths of the expectation of life belonging to others. Let us assume that this ratio is equally conservative as applied to all other cases of prolongable life. Now, it so happens that the expectation of life at birth in the Massachusetts life table of 1893–1897 is almost exactly three-fourths of the expectation which our table and diagram shows would be possible if prevention were properly practiced. This would give 45 years as the expectation of life at birth for the saved lives, 61 for other lives, and 59 for all lives. Surely this seems sufficient allowance for the existence of any possible inferiority among the lives which would be saved.

SECTION 7.—*Diagram "Possible I," making this allowance, compared with "Possible II," omitting it.*

If no allowance for inferiority among saved lives were necessary, the results of the calculation given in the table would be only a first approximation and

[a] "The cost of tuberculosis in the United States and its reduction," read before the International Congress on Tuberculosis, 1908.

would need to be followed by successive and closer approximations. We can get much quicker results by means of the diagram and a planimeter.

If we apply the ratios of preventability for these four groups, we are able to construct the new survivorship table on the basis of Mr. Abbott's for 1893–1897. All that is necessary is to begin the new survivorship table at the same point that the old begins, and continue from that point and every other point throughout its course by the following procedure: Through the point draw a line downward and to the right for one year, at the same percentage slope as Abbott's table shows for that year. This line indicates what survivors there would be if their mortality were not affected at all by the ratio of preventability. The deaths during that year would be represented by the drop of the curve within the year. Next, taking the proper fraction of this drop, as indicated by the ratio of preventability, we pass vertically upward this amount from the end of the line, and from the new point so obtained proceed in like manner for each subsequent year. The result is a series of teeth the upper points of which are points on the required curve. Joining these points, we obtain the curve. This process explains the theory. This gives the table called "Possible I," and takes full account of the fact that the ratios of preventability continue to apply to saved life as much as to other life. The table "Possible I" represents the survivorship table, under the assumption that the lives saved once are given no further advantages, but follow thereafter the old law of mortality, that for 1893–1897.

SECTION 8.—*Reciprocal relation between longevity and mortality shown by diagram.*

We may take this opportunity to explain, for the benefit of the general reader, the reciprocal relations existing between the death rate in a stationary population and the average duration of life. Consider the diagram "Massachusetts, 1893–1897." It shows the life history of 100,000 persons born. Let us suppose a community unaffected by emigration or immigration, and in which there are 100,000 births each year. Let us suppose, further, that the 100,000 persons born each year die afterwards according to the law of mortality represented by the curve "Massachusetts, 1893–1897." Evidently in such a community there will not only be 100,000 births, but there will be 100,000 deaths each year, and the population will be stationary. It will also be true that the same diagram can be taken to represent the age distribution of this stationary population. Thus, those living at age 10 will be the survivors of the 100,000 born ten years ago, and the number of such survivors is the ordinate of the curve at 10 years. Thus, every ordinate of the curve represents not only the survivors to a certain age out of 100,000 births, but also represents the number in the population at that age. The area of the curve therefore represents total population (when regarded as made up of vertical sections). It likewise represents the total number of years lived by 100,000 persons (when regarded as made up of horizontal sections). Now, the death rate is the ratio of deaths to population—i. e., the ratio of 100,000 to the area of the curve. The average duration of life is the total years lived by 100,000 persons divided by 100,000—that is, it is the area of the curve divided by 100,000. These are clearly reciprocals.

CHAPTER XII.—*The money value of increased vitality.*

SECTION 1.—*Money appraisal of preventable wastes.*

Estimates of the money value of preventable wastes depend on the valuation of *human life*, of which several appraisals have been attempted.

Prof. J. S. Nicholson estimated that in Great Britain human labor capitalized was worth five times all other capital.[a]

Engel computed that each child costs 100 marks at birth, 110 marks the first year, 120 the second, and so on. At 20 he will have cost 2,310 marks, or $560. But one-half die before 20. Hence each person who reaches the age of 20 actually costs society much more than $560; possibly as high as $1,000, if Engel's estimates are correct. Professor Mayo-Smith estimated that men and women between the

[a] See "The Living Capital of the United Kingdom," (British) Economic Journal, 1891.

ages of 15 and 45 averaged $1,000 in value.[a] As to the value of immigrants to this country, he says: "Every immigrant must represent labor value with at least the value of a slave. It is figured that each immigrant is worth $875."[b]

The best method of estimating the economic value of life and its increased duration is by the capitalization of earning power. Dr. William Farr, of England, has estimated that a baby born to an English agricultural laborer is worth in capitalized earning power about £5, or $25. This is the discounted value of its future earnings estimated on its probable life less the discounted value of the cost of rearing it during the period of dependence and of maintaining it when helpless through old age. In the same way he estimates the value of a life at other ages—10 years, 20 years, 50 years, etc.[c]

In lieu of any estimates for the United States we may take Farr's figures for agricultural laborers as representing, roughly, the relative worth of a man or woman in the United States. To obtain the absolute figures, therefore, we need simply to multiply these of Farr by a constant factor representing the ratio between the average earnings in the United States and the earnings which Farr uses as the yearly income of an agricultural laborer.

We take, in the absence of any good statistics, $700 per annum as a guess, but a safe minimum[d] for the average earnings of workers of all grades, from day laborers to railroad presidents. This assumes that all of the working years are actually employed in work. But since about one-fourth of the persons of working age are not workers, but are supported (for the most part) by earnings of capital, the average should be cut down to three-fourths of this figure, or $525.

Substituting this figure for the £31 in Farr's table, we can reconstruct it to represent the minimum worth of the average American life at different ages. The following figures are taken from the table thus computed:

Age.	Net worth of a person, in dollars.	Age.	Net worth of a person, in dollars.
0	90	30	4,100
5	950	50	2,900
10	2,000	80	−700
20	4,000		

From the table from which these figures are taken it is possible to base minimum estimates for (1) the average economic value of the inhabitants of the United States by using the census figures for age

[a] Mayo-Smith, Statistics and Sociology, p. 177.

[b] Mayo-Smith, Emigration and Immigration.

[c] See Farr, "Vital Statistics," p. 536.

[d] See Fisher "Cost of tuberculosis," read before the International Congress on Tuberculosis, Washington, 1908. This is the estimated minimum used in my paper on the "Cost of tuberculosis." The calculations are based on $1 a day as the ordinary minimum earnings of unskilled labor, and assume a distribution of a number of earners of high amounts according to the scale of distribution which Professor Pareto finds fairly uniform in form, although not in amount in various countries. The late Honorable Carroll D. Wright, whose opinion was worth more, probably, than that of any other man in the United States, stated that he would not regard $1,000 as excessive. The figure is intended to include the earnings of women (including housewives as earners).

distribution of population; this calculated average is $2,900; (2) the average economic value of the lives now sacrificed by preventable deaths, using the age distribution of deaths, and the percentages of preventability; this calculated average is $1,700.

The first figure shows that what might be called the vital assets of the United States for the population of over 85,500,000, as estimated by the census of 1907, amount in value to 85,500,000×$2,900, or $250,000,000,000, which, though a minimum estimate, greatly exceeds the value of all other wealth;[a] the second figure enables us to estimate the needless waste of our vital assets.

If we take the estimate of Professor Willcox of the death rate in the United States, as at least 18 per 1,000 for the 85,500,000 persons estimated by the census as the population of the United States in 1907, we have 1,500,000 as the number of deaths in the United States per annum. Of these 1,500,000 deaths, 42 per cent, or 630,000, are annually preventable or postponable. Since each postponement would save on the average $1,700, the national annual unnecessary loss of capitalized net earnings is 630,000×$1,700, or $1,070,000,000, or about $1,000,000,000.

We saw in Chapter III that, with our present population, there are always about 3,000,000 persons in the United States on the sick list. For the most part these persons are older than the average. Farr gives a table[b] showing that morbidity increases with age in geometric progression. By means of his table we may calculate on the same basis as the previous calculations—that of the 3,000,000 sick, very close to a third, or 1,000,000 persons, are in the working period of life. Assuming that average earnings in the working period are $700, and that only three-fourths of the one million potential workers would be occupied, we find over $500,000,000 as the minimum loss of earnings.

The cost of medical attendance, medicine, nursing, etc., is conjectured by Doctor Biggs in New York to average for the consumptive poor at least $1.50 per day of illness. The cost per day of other illnesses than tuberculosis is presumably greater, and also the cost per day for other classes is higher than for the poor. Applying this to the 3,000,000 years of illness annually experienced, we should have $1,500,000,000 in all as the minimum annual cost of this kind.

The statistics of the Commissioner of Labor[c] show that the average expenditure for illness and death amount to $27 per annum. This is for workingmen's families only. But even this figure, if applied to the 17,000,000 families of the United States, would make the total bill for caring for illness and death $460,000,000. The true cost may well be more than twice this sum. Certainly this estimate is more than safe and is only one-third of the sum obtained by using Doctor Biggs's estimate.

The sum of the costs of illness, including loss of wages and cost of care, is thus $460,000,000+$500,000,000, or $960,000,000.

The above estimate is a general one for all illness. It would be possible to offer figures for the particular losses from particular dis-

[a] Mr. Le Grand Powers, of the Bureau of the Census, Washington, estimates that the total wealth in America (exclusive of human beings) amounts to $107,000,000,000.

[b] Vital Statistics, p. 510.

[c] Eighteenth Annual Report, 1903, p. 509.

eases. Thus, from tuberculosis, the gross loss of earnings by illness and of potential earnings cut off by death, together with the expenses of illness, etc., amount to over $1,000,000,000 per annum.[a]

Of the sum mentioned, the loss to the consumptives themselves amounts to over $660,000,000, leaving $440,000,000 as the loss to other members of the community. At least three-fourths of these costs are preventable. Dr. George M. Kober thinks it is conservative to say that the annual cost of typhoid in the United States is $350,000,000[b] and Dr. L. O. Howard believes that malaria alone costs the country $100,000,000 annually, and the insect diseases generally $200,000,000.[c] He points out that one great item of loss is the reduced value of real estate in malarial regions. By drainage and destruction of mosquitoes most of this waste could be saved. The cost of the care of the insane and feeble-minded is estimated by Charles L. Dana at $85,000,000 annually.[d] What fraction of these costs is preventable it is difficult to say. The economic loss due to alcohol has been variously estimated.[e] Of the billion dollars or more found to represent the cost of illness, by far the major part is certainly avoidable. This is the belief of the best observers, such as Doctor Gulick, Doctor Kellogg, Mrs. Richards, Doctor Anderson, and others. Unfortunately there are no exact statistics of preventability. We feel safe, however, in concluding that at least half a billion could be saved from the present cost of illness. This, added to the loss by preventable deaths of potential earnings of a billion, gives at least a billion and a half of preventable waste. This does not include the losses from inefficient work due to drunkenness or other vicious habits; nor does it include the cost of "undue fatigue," which we have some reason to believe exceeds in its effect on efficiency the loss from illness. But it would not be possible to state this loss in any definite or convincing figures.

The actual economic saving annually possible in this country by preventing needless deaths, needless illness (serious and minor), and needless fatigue, is certainly far greater than one and a half billions, and may be three or more times as great.

Dr. George M. Gould estimated that sickness and death in the United States cost $3,000,000,000 annually, of which at least a third is regarded as preventable.[f]

The trouble is the public does not believe in this waste from being "just poorly," and "so as to be about." It has no conception of the difference between working with a clear brain and steady hand and with a dull and nerveless tool. They must be convinced somehow.[g]

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[a] See Irving Fisher: "Cost of Tuberculosis in the United States, and its Reduction."

[b] See his "Conservation of life and health by improved water supply," read before the White House Conference of Governors, 1908.

[c] Report to Conservation Commission on "Economic loss to the people of the United States through insects that carry disease."

[d] See "Psychiatry in its relation to other sciences," by Charles L. Dana, before the section on psychiatry at the International Congress of Arts and Sciences, St. Louis, September, 1904.

[e] "Economic aspects of the liquor problem." An investigation made for the Committee of Fifty, under the direction of Henry W. Farnam, secretary of the economic subcommittee, 1899, 327 pages.

[f] "Disease and Sin," American Medical Journal, August 31 and September 7, 1901.

[g] Letter from Ellen H. Richards.

SECTION 2.—*The cost of conservation.*

It costs no more to "raise" a man capable of living for 80 years than it does to "grow" one who has not the capacity of living to be 40 years old.[a]

We have seen how much potential value of life is now allowed to be wasted which could be prevented. But the question remains, What would it cost to conserve it? It is, of course, not possible to answer this question definitely and fully. The best we can do is to point out specific instances of the health returns which follow on investments in the improvement of vital conditions.

The following examples will show the returns which may be expected from well-planned expenditures on behalf of public health:

The city of Pittsburg is just installing a great municipal filter plant for the purification of its principal water supply, at an expense of upward of $7,000,000. It is reasonable to estimate that in a year or two this should effect a saving of 100 deaths a year from typhoid fever, for the number of typhoid-fever deaths of late years has been 400 or more yearly. Valuing these lives at $5,000 each, as is customary, the saving effected by the purification works should be half a million dollars' worth of human life annually, making the building of the filter a sound and profitable economic as well as humanitarian measure. But if, as Mr. MacNutt and I have shown, Hazen's theorem is true, then for every 100 deaths saved from typhoid fever at least 200 will be saved from other causes, which means at least $1,000,000 more saved to the city of Pittsburg annually of its present waste of human life.[b]

England reckons that the lives saved through the lowered death rate, from what it was between 1866 and 1875 to what it became in the period reaching from 1880 to 1889, amounted to 858,804. This represents on the English basis of the per capita valuation of each life ($770) a social capital of $650,000,000 saved. In ten years England has more than regained the sum spent in fifteen years for sanitary improvements, though the average annual expenditure has been $42,000,000.[c]

The achievement of Huddersfield, England, is especially noteworthy. The average number of deaths of infants for ten years had been 310. By a systematic education of mothers the number was in 1907 reduced to 212. The cost of saving these 98 lives was about $2,000.[d]

A saving of infant life is recorded by Doctor Chapin in Providence:

We attempted for two years to distribute clean milk to the babies of the poor, but this year we decided that the money could better be spent on trained nurses. Thus far we have expended about $900 for this purpose. Two hundred and thirty-five sick children, of whom very many were very sick, have been cared for. Of these only 20 have died. From a study of our statistics I should judge that the reduction in infant mortality effected by the nurses was at least 25 deaths, and it may be that as many as 40 lives were saved.[e]

At the funeral of Maj. Walter Reed, the man who did so much to prove the correctness of Doctor Finley's discovery that the mosquito is the carrying agent for the yellow-fever germ, Gen. Leonard Wood

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[a] T. S. Lambert: "Sources of Longevity," New York, 1869, p. 6.

[b] W. T. Sedgwick: "The call to public health," Science, 1908, p. 198.

Since the foregoing was written, there has appeared in "Charities," February 6, 1909, "Thirty Five Years of Typhoid" by Frank E. Wing, in which it is shown that there were in 1907, in Pittsburg, 4,921 cases of typhoid, of which 622 died; and that the cost per patient, irrespective of the lives lost, was $128, making the cost for the city $694,000. Reckoning $4,000 as the value of each life lost, the total annual money cost from typhoid in Pittsburg is over $3,000,000, and, according to Hazen's theorem, already mentioned, this is probably not one-half nor even one-third of the total.

[c] Ditman, loc. cit., p. 4. Taken from M. G. Dana: "Results of municipal sanitation," Annals of Hygiene, 1896, Vol. II, p. 391.

[d] Letter from Dr. Charles V. Chapin.

[e] Ibid.

declared that this discovery is saving more lives annually than were lost in the Cuban war, and that it is saving the commercial interests of the world a greater financial loss each year than the cost of the entire Cuban war.[a]

As to what the stamping out of yellow fever means, in money terms, the following is significant:

It has been estimated that the yellow fever epidemic of 1878 invaded 132 towns, caused a mortality of 15,954 persons, and that the pecuniary loss to the country was not less than $100,000,000 in gold.[b]

The economic loss to Philadelphia, caused by the smallpox epidemic of 1871–72, has been estimated by Doctor Lee at $22,000,000. This includes loss to travel and traffic on railroads, loss to hotel keepers, merchants, and manufacturers, cost of care of sick, loss of time, and the expense of burial. A vaccine bureau with physicians, a disinfecting station, and the inauguration of a campaign of education capable of forestalling the whole epidemic would have cost $700,000.[c]

It is reported that San Francisco plans an investment of $30,000,000 in stone and concrete quays to prevent rodents from infecting the city, and this is regarded by experts as worth while many times over.

In respect to hook-worm disease, rating the earning per diem of the southern farm laborer at 75 cents, 28 observers report that average laborers infected with hook-worms earn 40 cents per diem. Ten observers having cotton-mill practice report unanimously that the disease is very prevalent among cotton-mill laborers, and rating the average mill laborers at $1.50 per diem, they consider 75 cents as a fair rating for hook-worm bearing laborers.[d]

It would be difficult to even roughly estimate the cost of this disease to the South, but from what we know of it in this State I would say that it costs South Carolina not less than $30,000,000 per year, and this inability to perform regular and efficient labor is the smallest part of the cost.[e]

It has been figured that the hook-worm disease of the South could be wiped out within a generation[f] through the expenditure of from one to two millions of dollars by federal and state agencies. It costs about 15 to 75 cents (wholesale) for drugs to cure a case of hook worms. In three months the quantity of red corpuscles in the blood can easily be increased 10 to 50 per cent, according to the severity of the case, and the[g] absenteeism of the victims could easily be reduced 25 per cent.

Another noteworthy result of well-directed sanitary effort is the reduction of hook-worm disease in Porto Rico. As you are doubtless aware, this disease causes a tremendous lowering of the physical efficiency of the people of that island. As you may see by the report of the special commission for 1906 and 1907 made to Governor Post, 89,000 people were treated, and for the most part cured, for 54 cents each.[h]

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[a] Ditman, loc. cit., p. 12.

[b] Walter Wyman, M. D., "Quarantine and Commerce," address before Cincinnati Commercial Club, October 15, 1898, p. 8.

[c] Ditman, loc. cit., pp. 8–10, from Bissell, A Manual of Hygiene.

[d] Letter from Dr. W. J. Burdell.

[e] William Weston, "Uncinariasis," South Carolina Medical Association, 1908, p. 8.

[f] Dr. Charles W. Stiles, of the United States Public Health and Marine-Hospital Service, who has studied the hook-worm disease more thoroughly than any one else in the country.

[g] Letter from Doctor Stiles.

[h] Letter from Charles V. Chapin, 1908.

Medical inspection in our schools also returns large dividends on small investments.

Using these data as a basis, we have the annual expenditure for medical inspection of $345,135 in those cities from which we have succeeded in obtaining data. It seems probable, although this is frankly a guess, that the total annual expenditure for medical inspection of schools in the United States at the present time is perhaps $500,000.[a]

The money saved by enabling thousands of children to do one year's work in one year, instead of in two or three years, would greatly exceed the total expense of examining all school children in all boroughs.[b]

Doctor Jessen has shown that the cost of a school dental clinic in Germany is only one mark per year per child.[c] The cost saved must be very many times this sum. Dr. Herbert L. Wheeler, of New York, estimates that the Children's Aid Dental Clinic in New York cost $342 for the last fiscal year (35 cents per operation and 70 cents per child treated). He reckons that the neglect of these slight repairs would later have cost far more in dentistry, as well as over $2,000 worth of lost time. These losses are of course of minor importance compared with the pain, inconvenience, and secondary effects on health and efficiency which are inevitably associated with bad teeth.

Mr. Edwin Chadwick, who was once secretary of the English National Board of Health, stated that a sanitary "engineer ought to contract for the reduction of the sickness and death rate, in such a city as Glasgow, by at least one-third, for a penny a head of the entire population."[d]

It is necessary, if we are to do our utmost, to spend a thousand pounds of public money on this task where we now spend one pound. It would be reasonable and wise to expend ten million pounds a year of our revenues on the investigation and attempt to destroy disease. Actually what is so spent is a mere nothing, a few thousands a year. Meanwhile our people are dying by thousands of preventable disease.[e]

Mr. Hiram J. Messenger, actuary of the Travelers Insurance Company, of Hartford, has constructed and sent me a table showing that life insurance companies could probably make money now by taking a hand in the public-health movement, with the purely commercial object of reducing their death losses. He says:

This table shows that if the companies were to expend $200,000 a year for this purpose and as a result should decrease their losses by the almost insignificant amount of twelve one-hundredths of 1 per cent, they would save enough to cover the expense. If such a plan as this were placed on a purely scientific basis and carried out by good business methods and all the companies pulled together for the common good, I should expect a decrease in death claims of more than 1 per cent. And a decrease in death claims of 1 per cent would mean that the companies would save more than eight times as much as they expended or would make a net saving of more than seven times the expense—which would be about a million and a half dollars a year.

The examples given show tangible returns on the investment of several thousand per cent as a rule. While it would be impossible to

[a] Letter from Dr. Luther H. Gulick.

[b] Sixty-third Annual Report of the Association for Improving the Condition of the Poor, New York, 1906.

[c] See "Jahresbericht der Städtischen Schulzahnklinik in Strassburg," in Odontologische Blätter 12, No. 15–16, 1907.

[d] Transactions of the British Social Science Association, 1866, p. 580. Quoted by Dr. Edward Jarvis, Political Economy of Health, Fifth Report, Mass. Board of Health, 1874, p. 367.

[e] E. Ray Lankester, "The Kingdom of Man," New York (Holt), 1907, p. 148.

state in general terms how rich a return lies ready for public or private investments in good health, the foregoing examples and numerous others show that the rate of this return is quite beyond the dreams of avarice. Were it possible for the public to realize this fact, motives both of economy and of humanity would dictate immediate and generous expenditure of public moneys for improving the air we breathe, the water we drink, and the food we eat, as well as for eliminating the dangers to life and limb which now surround us.

CHAPTER XIII.—*The general value of increased vitality.*

SECTION 1.—*Disease, poverty, and crime.*

In the preceding chapter we have attempted to estimate in money the preventable wastes from disease and death. Although the figures for national losses strike the popular imagination, they have little significance; in fact, money estimates in this field, even when made on the per capita basis, are of little value except as emphasizing the overwhelming importance of human vitality compared with those interests which are usually measured in money. It is impossible in any true sense to measure human life in terms of dollars and cents.[a]

The measure of life may perhaps be found in happiness, or the satisfactions enjoyed between birth and death, less the dissatisfactions.

Is life worth living? has been a much asked question, especially since Mr. Mallock wrote a book with that title. The witticism sometimes given in answer, "That depends upon the liver," is true in both of its two meanings. A life of happiness is always worth living, and a life of usefulness, which brings happiness to others, is doubly worth living.

It is hardly necessary to recount all the conditions which tend to produce happiness. No one would question that the most fundamental condition of all is health, in spite of exceptional cases in which unhealthy people are found happy, and healthy people unhappy. It would be impossible to express in exact terms the extent to which improved health could increase human happiness; but every observer of human misery among the poor reports that disease plays the leading rôle. Students of criminology and vice agree that these are chiefly the result of morbid conditions and habits. Health reform brings in its train great and lasting reductions in poverty, criminality, and vice.

We began this report by showing the relation between the conservation of health and the conservation of wealth. The broadest view of this relation is, as Emerson has said, that "Health is the first wealth," and as such it is treated by many economists.[b]

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[a] Even as a measure of what economists call "utility," a money estimate is misleading, for the reason that the "marginal utility" of money varies with different persons. For instance, a week's wages of $10 lost to a poor wage-earner is in such an estimate counted on a par with an expenditure of $10 by a wealthy invalid for a dainty morsel of food, although the loss in "utility" to the former is vastly greater than that to the latter.

[b] Among those who have included health in the category of wealth are Davenant, Petty, Canard, Say, McCullough, Roscher, Wittstein, Walras, Engel, Weiss, Dargun, Ofner, Nicholson, and Pareto. See Irving Fisher: "The Nature of Capital and Income," New York (Macmillan), 1906, p. 5.

Without enlarging or insisting upon this concept, it is obvious that by the conservation of health we may ultimately save billions of dollars of wasted values, and that this conservation is intimately related to conservation of all other kinds.[a]

We have already seen the vicious circle set up between poverty and disease, each of which tends to produce the other. Metchnikoff[b] contends that health and morality are correlative, if not interchangeable, terms. A similar idea has been elaborated statistically by Dr. George M. Gould.[c] The subject is worth much further study. National efficiency is crippled by any one or all of the parts of the vicious circle—disease, poverty, vice, vagabondage, crime. It would be interesting to study the tramp problem, which represents an enormous waste of labor power, in relation to all these phenomena.

SECTION 2.—*Conservation of natural resources.*

It is also true that health begets wealth, and vice versa. Whatever diminishes poverty or increases the physical means of welfare has the improvement of health as one of its first and most evident effects. Therefore an important method of maintaining vital efficiency is to conserve our natural resources—our land, our raw materials, our forests, and our water. Only in this way can we obtain food, clothing, shelter, and the other means of maintaining life. Conversely, the conservation of health will tend in several ways to the conservation of wealth. First of all, the more vigorous and long-lived the race, the better utilization can it make of its natural resources. The labor power of such a race is greater, more intense, more intelligent, and more inventive.

The development of our natural resources in the future will be more dependent on technical invention[d] than upon the mere abundance of materials.

Just as in warfare it is not so much the gun as the man behind the gun that makes for success, so in industry, as Doctor Shadwell[e] has shown, skill, knowledge, and inventiveness are the chief factors in determining commercial success and supremacy. The backward nations, like China, are characterized by lack of modern inventions. The nations which are industrially most advanced have the railway, the steamship, the power loom, metal working, and innumerable arts and crafts. The change of Japan from a backward to a forward nation is at bottom the introduction of inventions. If conservation prevents lessened fertility, invention makes two blades of grass grow where one grew before.

Future industrial competition will be increasingly a contest of invention. The world rivalry to develop the best system of wireless telegraphy or the best airships is but one example. The future will see the greatest strides taken by the nation which is the most invent-

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[a] See Edward Devine, "Efficiency and Relief," New York (Macmillan), 1906.

[b] "Prolongation of Life," p. 318.

[c] "Disease and sin," American Medical Journal, Aug. 31 and Sept. 7, 1901.

[d] Since the above was written, President Charles S. Howe, of Cleveland, has presented this point in detail. See "The function of the engineer in the conservation of the natural resources of the country," Science, Oct. 23, 1908.

[e] Arthur Shadwell in his admirable "Industrial Efficiency" (2 vols.). London (Longmans), 1906.

ive. Now, the primary condition of invention is vitality, a clea brain in a normal body. It is no accident that Edison is a healt culturist, or that Krupp, Westinghouse, and other pioneers in indus trial development have been men of vigor of mind and body.

Finally, the conservation of health will promote the conservatio of other resources by keeping and strengthening the faculty of fore sight. One cause of poverty in the individual and the nation is lac of forethought.[a]

One of the first symptoms of racial degeneracy is decay of fore sight. Normal, healthy men care for and provide for their descend ants. A normal, healthy race of men, and such alone, will enac the laws or develop the public sentiment needed to conserve natura resources for generations yet unborn. When in Rome foresigh was lost, care for future generations practically ceased. Physica degeneracy brought with it moral and intellectual degeneracy. In stead of conserving their resources the spendthrift Romans, from th emperor down, began to feed on their colonies and to eat up thei capital. Instead of building new structures they used their old Coliseum as a quarry and a metal mine.[b]

The problem of the conservation of our natural resources is there fore not a series of independent problems, but a coherent all-embra cing whole. If our nation cares to make any provision for its grand children and its grandchildren's grandchildren, this provision mus include conservation in all its branches—but above all, the conserva tion of the racial stock itself.

Chapter XIV.—*Things which need to be done.*

Section 1.—*Enumeration of principal measures.*

In order that American vitality may reach its maximum devel opment, many things need to be done. Among them are the fol lowing:

1. The National Government, the States, and the municipalitie should steadfastly devote their energies and resources to the protec tion of the people from disease. Such protection is quite as properly a governmental function as is protection from foreign invasion, from criminals, or from fire. It is both bad policy and bad economy to leave this work mainly to the weak and spasmodic efforts o charity, or to the philanthropy of physicians.

2. The National Government should exercise at least three public health functions: First, investigation; second, the dissemination o information; third, administration.

It should remove the reproach that more pains are now taken t protect the health of farm cattle than of human beings. It should provide more and greater laboratories for research in preventive medicine and public hygiene. Provision should also be made fo better and more universal vital statistics, without which it is impos sible to know the exact conditions in an epidemic, or, in general, the sanitary or insanitary conditions in any part of the country

[a] See Irving Fisher: "The Rate of Interest," New York (Macmillan), 1907

[b] See John Rae: "Sociological Theory of Capital," edited by Prof. C. W. Mixter, New York (Macmillan), 1905.

It should aim, as should state and municipal legislation, to procure adequate registration of births, statistics of which are at present lacking throughout the United States.

The National Government should prevent transportation of disease from State to State in the same way as it now provides for foreign quarantine and the protection of the nation from the importation of disease by foreign immigrants. It should provide for the protection of the passenger in interstate railway travel from infection by his fellow-passengers and from insanitary conditions in sleeping cars, etc.

It should enact suitable legislation providing against pollution of interstate streams.

It should provide for the dissemination of information in regard to the prevention of tuberculosis and other diseases, the dangers of impure air, impure foods, impure milk, imperfect sanitation, ventilation, etc. Just as now the Department of Agriculture supplies specific information to the farmer in respect to raising crops or live stock, so should one of the departments, devoted principally to health and education, be able to provide every health officer, school-teacher, employer, physician, and private family with specific information in regard to public, domestic, and personal hygiene.

It should provide for making the national capital into a model sanitary city, free from insanitary tenements and workshops, air pollution, water pollution, food pollution, etc., with a rate of death and a rate of illness among infants and among the population generally so low and so free from epidemics of typhoid or other diseases as will arouse the attention of the entire country and the world.

There should be a constant adaptation of the pure-food laws to changing conditions. Meat inspection and other inspection should be so arranged as to protect not only foreigners, but our own citizens. The existing health agencies of the Government should be concentrated in one department, better coordinated, and given more powers and appropriations.

3. State boards of health and state legislation should provide for the regulation of labor of women, should make physiological conditions for women's work and prevent their employment before and after childbirth; should regulate the age at which children shall be employed, make reasonable regulations in regard to hours of labor and against the dangers in hazardous trades, and especially against the particular dangers of dust and poisonous chemicals; should make regulations for sanitation and provide inspection of factories, schools, asylums, prisons, and other public institutions. Where municipalities have not the powers to enact the legislation above mentioned with reference to local conditions, the necessary legislation or authority should be provided by the State. Or where by reason of the small size of the town no efficient local action is possible, the State should exercise the necessary functions. It should in such cases advise and supervise local boards of health. It should have an engineering department and advise regarding the construction of sewers and water supplies. Pollution of such supplies, unless entirely local, should be prevented by the State, which should be equipped with laboratories for the analysis of water, milk, and other foods. Suitable legislation should be passed regulating the sale of drugs, especially preparations

containing cocaine, opium, or alcohol. Legislation—not too far in advance of public sentiment needed to enforce it—should be passed regulating the sale of alcoholic beverages. State registration of births, deaths, and cases of illness should be much more general and efficient than at present.

4. Municipal boards of health need to have more powers and greater appropriations; less political interference and better trained health officers; more support in public opinion. Their ordinances in regard to expectoration, notification of infectious disease, etc., should be better enforced by the police departments.

More legislation should be advocated, passed, and enforced to the end that streets may be kept clean, garbage properly removed, sewage properly disposed of, air pollution of all kinds prevented, whether by smoke, street dust, noxious gases, or any other source. Noises also should be lessened.

Municipalities need also to take measures to prevent infection being carried by flies, mosquitoes, other insects and vermin, and by prostitution. They need to guard with greater care the water supply, and in many cases to filter it; they should make standards for milk purity and enforce them; they should also regularly inspect other foods exposed for sale; provide for sanitary inspection of local slaughterhouses, dairies, shops, lodging and boarding houses, and other establishments within the power of the particular municipality; they should make and enforce stricter building laws, especially as relating to tenements, to the end that dark-room tenements may be eliminated and all tenements be provided with certain minimum standard requirements as to light, air, and sanitary arrangements.

5. School children should be medically inspected and school hygiene universally practiced. This involves better protection against school epidemics, better ventilation, light, and cleanliness of the schoolroom, the discovery and correction of adenoids, eye strain, and nervous strain generally, and the provision for playgrounds. Sound scientific hygiene should be taught in all schools, public, private, normal, and technical, as also in colleges and universities.

6. The curricula of medical schools should be rearranged with a greater emphasis on prevention and on the training of health officers. Sanatoria and hospitals, dispensaries, district nursing, tuberculosis classes, and other semipublic institutions should be increased in number and improved in quality. The medical profession, keeping pace with these changes, should be the chief means of conveying their benefits to the public. Universities and research institutions need to take up the study of hygiene in all its branches. Now that the diseases of childhood are receiving attention, the next step should be to study the diseases of middle life. These are diseases, to a large extent, of nutrition and circulation, and consequently these subjects should receive special attention. Intelligent action must rest on knowledge, and knowledge of preventing disease is as yet extremely imperfect.

7. In industrial and commercial establishments employers may greatly aid the health movement, and in many cases make their philanthropy self-supporting by providing social secretaries, lunch and rest rooms, physiological (generally shorter) hours of work, provision for innocent amusements, seats for women, etc.

Life insurance companies could properly and with much profit club together to instruct their risks in self-care and secure general legislation and enforcement of legislation in behalf of public health.

8. The present striking change in personal habits of living should be carried out to its logical conclusion until the health ideals and the ideals of athletic training shall become universal. This change involves a quiet revolution in habits of living, a more intelligent utilization of one's environment, especially in regard to the condition of the air in our houses, the character of the clothes we wear, of the site and architecture of the dwelling with respect to sunlight, soil, ventilation, and sanitation, the character of food, its cooking, the use of alcohol, tobacco, and drugs, and last, but not least, sex hygiene in all its bearings.

9. The fight against disease will aid in the fight against pauperism and crime. It is also true that any measures which tend to eliminate poverty, vice, and crime will tend to improve sanitary conditions.

10. Finally, eugenics, or hygiene for future generations, should be studied and gradually put in practice. This involves the prohibition of flagrant cases of marriages of the unfit, such as syphilitics, the insane, feeble-minded, epileptics, paupers, or criminals, etc. The example of Indiana in this regard should be considered and followed by other States, as also in regard to the unsexing of rapists, criminals, idiots, and degenerates generally. A public opinion should be aroused which will not only encourage healthy and discountenance degenerate marriages, but will become so embedded in the minds of the rising generation as will unconsciously, but powerfully, affect their marriage choices.

THE NEED

FOR

HEALTH INSURANCE

IRVING FISHER

PROFESSOR, POLITICAL ECONOMY, YALE UNIVERSITY

PRESIDENTIAL ADDRESS

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THE NEED FOR HEALTH INSURANCE

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In the last six months, through the efforts of the American Association for Labor Legislation, a consciousness of the imperative need in this country for health insurance has dawned upon thinking Americans. Within another six months it will be a burning question in many states. As Dr. Blue, surgeon general of the United States Public Health Service, has said, it is the next great step in social legislation in this country.

At present the United States has the unenviable distinction of being the only great industrial nation without compulsory health insurance. For a generation the enlightened nations of Europe have one after another discussed the idea and followed discussion by adoption. It has constituted an important part of the policy and career of some of Europe's greatest statesmen, including Bismarck and Lloyd George. Germany showed the way in 1883 under the leadership of Bismarck. This act was the first step in her program of social legislation. Her wonderful industrial progress since that time, her comparative freedom from poverty, reduction in the death rate, advancement in hygiene, and the physical preparedness of her soldiery, are presumably due, in considerable measure, to health insurance.

Following the example of Germany, health insurance was adopted successively by Austria, Hungary, Luxemburg, Norway, Serbia, Great Britain, Russia, Rumania, and Holland. Other countries have adopted a subsidized voluntary system, namely, France, Belgium, Switzerland, Denmark, Sweden, and Iceland. Thus the only European countries which, like the United States, are without any general system are Italy, Spain, Portugal, Greece, Bulgaria, Albania, Montenegro, and Turkey.

Because we have a democratic form of government we have peacefully assumed that our civilization is more advanced than others, but while we have rested complacently on our oars, other nations have forged ahead of us. The war has at last startled us out of our Rip Van Winkle slumber, and we are now passing through a period of national self-examination.

There are special reasons to hope that health insurance may win favor rapidly. The war has made labor scarce and therefore dear. This fact will make not only for high wages, but also for the conservation of labor. Students of the history of slavery find that when slaves were abundant and cheap, masters worked them to death and replaced them when worn out. Consequently, cruelty was condoned and fashionable. On the other hand, when slaves were scarce and dear, the masters took good care of them and a humanitarian sentiment developed to correspond. I believe it to be a correct economic portent that the world is about to enter upon a period of life conservation. The war has for a time withdrawn much of the world's labor supply and destroyed and maimed a large part of that which it has withdrawn. The world will seek the greatest possible salvage out of the wreck.

This impulse to conserve has at first been felt in terms not of industry, but of military preparedness. The strong impetus toward preparedness of all kinds has been the result. Witness the recent laws in New York for compulsory physical training in the public schools. Health insurance and other measures for health conservation will in turn be furthered by the same impulse toward conservation.

Fortunately we have already taken one step in a social insurance program. After a long and uphill fight, workmen's compensation has had a belated recognition in America. The American Association for Labor Legislation was foremost in this fight, and now at last it is ready for a similar fight to secure workmen's health insurance. For four years an able committee of this Association has been studying American conditions and foreign health insurance acts, and constructing a standard bill. This bill, with some variations, has been introduced into the state legislatures of Massachusetts, New York, and New Jersey, and commissions to consider the subject have been appointed in Massachusetts and California and are expected to report in January. It is significant that so large were the throngs which attended the public hearing of the Massachusetts commission on October 3 that the meeting place had to be twice changed during the hearing to larger quarters. During the ensuing year it is expected that the bill will be introduced in about twenty state legislatures.

The United States Public Health Service has issued a special study on *Health Insurance* by Dr. B. S. Warren and Edgar Sydenstricker. The American Medical Association has a working committee on health insurance of which Alexander Lambert is chairman and I. M. Rubinow secretary. This association has published

a report on social insurance. Several medical societies, including the Pennsylvania State Medical Society and the State Medical Society of Wisconsin, and several public health associations, have endorsed the principle of health insurance. The American Association for the Study and Prevention of Tuberculosis and many of its affiliated organizations have, through public meetings and otherwise, helped the movement. A number of charitable organizations have also favored the idea and forty-five organizations of various natures, including the American Academy of Medicine, the International Association of Industrial Accident Boards, the National Conference of Charities and Correction, the New York Chamber of Commerce, and the American Public Health Association have appointed committees to study and report upon health insurance.

The federal Commission on Industrial Relations recommended health insurance. In accepting favorably the report on health insurance of its industrial betterment committee the National Association of Manufacturers at its annual meeting last May put itself on record as favoring the project. The chairman of the same committee stated in July, 1914: "I give it as my opinion that sickness insurance of some kind, with compulsory contribution on the part of employers, will be enacted into law by many states of the union within the next five years." The Associated Manufacturers and Merchants of New York State have expressed their approval.

Many trade unions have taken up the subject. Some have strongly favored the idea; a few leaders have vigorously opposed it, apparently because of a groundless fear that in some way the power of the labor unions would be lessened. Thus some oppose health insurance as they at one time opposed compulsory workmen's compensation. On the other hand several international unions, including the International Typographical Union, have definitely gone on record as favorable. State federations of labor in Ohio, New Jersey, Massachusetts, Missouri, Nebraska, and Wisconsin are favorable. A number of local trade unions have taken favorable action. Many individual labor leaders of prominence have definitely approved it; these include John Mitchell, Ignatius McNulty, Van Bittner, James H. Maurer, Andrew Furuseth, S. E. Heberling, John B. Lennon, James O'Connell, Austin B. Garretson, William Green, and James Duncan.

The cordial and almost unprecedented welcome which this movement has received in spite of the opposition of strong vested interests and their industrious and insidious efforts to misrepresent and injure the movement would seem to indicate that the time for health insurance in the United States is ripe.

The plan as put forth by the American Association for Labor Legislation is fully described in its draft of a standard bill and defended in its *Brief for Health Insurance.* The bill proposes the obligatory insurance of substantially all workingmen and women. In case of sickness the insured will receive medical or surgical service, medicines, and nursing, and a cash benefit amounting to two-thirds of the weekly wages of the insured for the period of illness up to six months. Maternity benefits are provided for childbirth, and funeral benefits for death.

Benefits are paid for at cost by the joint contributions of the insured employee, his employer, and the state. The cost to the employee will average about 1½ per cent of his wages. The cost to the employer will be an equal amount, while the state will pay half as much as either the employer or the employee. These are the main points covered in the standard bill. I am here concerned, however, not with the merits of this particular plan but with the need of some plan of universal health insurance for workmen.

The need for health insurance, like that for most other forms of insurance, is twofold. There is the need of indemnification against loss, and the need of diminishing the loss itself.

Indemnification is the essence of the insurance principle. It spreads the loss of each person in a group over them all. For each individual it converts large fluctuating haphazard losses into small regular and certain costs. Insurance aims to reduce fluctuations—to make the income stream more steady. It is more economical to pay a little premium for fire insurance each year than to suffer a big loss when the fire comes. This insurance principle is of the greatest importance in economics and in business. The well-to-do have long made use of it in fire insurance, marine insurance, life insurance, fidelity insurance, plate glass insurance, steam boiler insurance, and, to some extent, accident and health insurance. The capitalist has long endeavored to eliminate, or at least to reduce, every determinable risk. But the curious and melancholy fact is that outside of workmen's compensation the poor in this country have received, as yet, very little benefits from the application of the insurance principle. Yet it is the poor whose need of health insurance is greatest, and for two important reasons. One is that the worker is more likely to lose his health than the capitalist; for it is well known from several lines of research that the death rate, and therefore the sickness rate, prevailing among the poor is from two to three times that prevailing among the well-to-do. The other reason is that any loss from sickness is a far more vital matter

to the poor than to the rich. That low-paid workingmen seldom insure against illness is undoubted.

No very exact or recent estimate on this point seems to be available, but according to a study of the Connecticut Bureau of Labor Statistics in 1891 the great bulk of membership in fraternal societies was at that time made up of the well-to-do; only a small fraction, from one-sixth to one-third, consisted of "low-paid mechanics and clerks." Moreover, these societies do not always provide health insurance. Certain it is that as yet the amount of voluntary health insurance in the United States such as that under fraternal societies, labor unions, establishment funds, and insurance companies, covers only a small fraction of workingmen and women. Judging from the tentative estimates of Rubinow, only about 5 per cent of our workmen needing insurance actually have it. The other 95 per cent have been deterred by the high cost of such insurance under the voluntary system, by their lack of appreciation of its benefits, by the inertia of custom, and by the sheer desperation of poverty.

To ascertain the exact extent of health insurance in the United States we need further investigation, but we know with certainty that the amount is small. Even in England, where friendly societies have had voluntary health insurance for generations and developed it far beyond the United States or any other country, the number of the insured was never half that to be reached by the compulsory system. This was demonstrated by the fact that when the compulsory system was actually introduced in 1911 the number of the insured was at once more than doubled. Presumably the half that needed it most was the half that lacked it until the universal system was adopted. From these facts it is apparent that the present insurance facilities in the United States are, and, as far as we can see, always will be hopelessly inadequate.

It is also true that millions of American workmen cannot at present avail themselves of necessary medical, surgical and nursing aid. When they most need it they cannot pay for it. The Rochester survey of the Metropolitan Life Insurance Company showed that 39 per cent of the cases of illness did not have a physician in attendance.

Workmen's health insurance is like elementary education. In order that it shall function properly it needs must be universal, and in order to be universal, it must be obligatory. In regard to obligatory military training it has been said that what America most needs to-day is a higher appreciation of obligation and that without it we shall ever be a drifting, weak, and inefficient nation.

The case for compulsory health insurance is, however, far clearer than that for compulsory military training. In health insurance, as in education, we are dealing not with obligatory burdens, but with obligatory benefits.

Certain interests which would be, or think they would be, adversely affected by health insurance have made the specious plea that it is an un-American interference with liberty. They forget that compulsory education, though at first opposed on these very grounds, is highly American and highly liberative, that prohibitory laws on various subjects such as habit-forming drugs and even alcohol have introduced liberative compulsions in many states in America, and that workmen's compensation acts have introduced liberative compulsion in this very field of workingmen's insurance. The truth is that the opponents of compulsory health insurance are in every case, as far as I can discover, subject to some special bias. They grasp at the slogan of liberty as a subterfuge only.

Oh liberty! liberty! How many crimes are committed in thy name!

According to the logic of those now shedding crocodile tears over health insurance we ought, in order to remain truly American and truly free, to retain the precious liberties of our people to be illiterate, to be drunk, and to suffer accidents without indemnification, as well as to be sick without indemnification. In fact, if compulsory health insurance is tyranny, all labor laws, all tenement laws, all health laws, all pure food laws, even *all* laws, are tyranny. In fact, all laws are an interference with some one's liberty, even laws against vice and crime. It is the nature of the Law to restrict. But it is by the compelling hand of the law that society secures liberation from the evils of crime, vice, ignorance, accidents, unemployment, invalidity, and disease.

We have already seen that most of the enlightened and progressive nations of the world have, one after another, adopted compulsory health insurance. This would not have happened if it were a real interference with liberty. England, the most liberty loving of nations, the home of laissez-faire, adopted the compulsory system after careful and deliberate study of the German and other systems.

It is also noteworthy that where, as in Switzerland, France, and Belgium, the half-way stage has been reached of a subsidized voluntary system, the tendency has been to convert this into a compulsory system. Such a change was about to be put on the statute books in Belgium when the present war broke out.

In addition to the primary advantage of universality, there are incidental advantages in the compulsory system. There are important economies in administration owing to the elimination of the cost of collection, the cost of advertising, and the other costs of securing business as well as in the elimination of lapses, and of the necessity for accumulating a large actuarial reserve in invested funds. The advantages are similar to those recently realized by insurance companies in some degree and on a small scale in "group insurance."

The superintendent of insurance of the District of Columbia reports that the people who pay health insurance premiums to agents who collect 10, 15, and 25 cents a week at the homes of policy holders "have to give up $1 for every 40 cents they get back." The National Convention of Insurance Commissioners in their examination of the fourteen principal companies writing industrial health and accident insurance found that the ratio of losses showed that the policy holders spent $1 to receive back a benefit of between 30 and 46 cents. These figures are in striking contrast to the results of the compulsory system abroad; even in England where the cost of administration is high because of the supposed necessity of utilizing preexisting friendly societies, the administrative cost amounts to only 14 per cent of the income of the national health insurance fund, or something like one-fourth to one-third the cost under the voluntary system.

Under the voluntary system the policy is apt to lapse just when it is most important that it should not. The Armstrong investigating committee in New York (1906) received testimony from one of the largest of the industrial life insurance companies to the effect that one-third of the policies lapse within three months, one-half within a year, and nearly two-thirds within five years! Under the compulsory system there could be no lapses.

As important as is indemnification, it is far less important than prevention. Almost all insurance sooner or later adds the function of the prevention of loss to that of indemnifying against loss. Fire insurance has led to the use of slow-burning construction and other safeguards against destruction by fire. Marine insurance has led to safety at sea. Some steam boiler insurance companies expend as much as 40 per cent of their income in inspection and other preventive work. Life insurance companies are now instituting devices for extending human life.

It is well known that the form of social insurance recently adopted in the United States, namely "workmen's compensation," has had the effect of greatly stimulating industrial methods in

accident prevention. Out of workmen's compensation came the "Safety First!" slogan and the public movement which it represents. J. D. Beck, of the Wisconsin Industrial Commission, declared that more progress in accident prevention had been made in his state in one year under workmen's compensation than in any previous period of five years.

The importance of prevention depends in any individual case on the degree of preventability, and in the case of human morbidity the degree of preventability is enormous. Even in the last few years there have been opened up hitherto undreamed of possibilities for adding to life's length, vigor, and happiness.

The health movement can be far more potent than the safety movement because sickness is more prevalent and more preventable than accidents. Pasteur convinced us that "It is within the power of man to rid himself of every parasitic disease," and his successor, Metchnikoff, went far to show us that the normal life span, the Utopian ideal for future generations, is much beyond the century mark. Without looking so far ahead we may, I think, accept as conservative the calculations of the National Conservation Commission that at least 42 per cent of the deaths now occurring in the United States are unnecessary, or that over 630,000 lives could be saved annually by applying existing and known methods of life saving, which would add at least fifteen years to the average duration of human life. These estimates are doubtless over-conservative, as may be judged from the data of the Commission on Industrial Relations, from the recent health surveys of the Metropolitan Life Insurance Company, and from other evidence.

After some fifteen years' study of the preventability of sickness, I am convinced that the great virtue of health insurance, for decades, perhaps for centuries to come, will lie in the prevention of illness. It has already achieved considerable life saving in Germany, although when the system was established there the idea of the preventability of disease was in its infancy. According to Dr. Zacher, reputed to be the best authority on health insurance in the world, twelve years were added to the worker's life span during thirty years of health insurance. We may properly attribute part, if not most of this increase, to health insurance. This prolongation of life is at the rate of forty years a century, the highest rate of increase known in any country or any period of time.

Health insurance will afford a very powerful and pervasive stimulus to employers, employees, and public men to take fuller and speedier advantage of possible health saving devices. The standard bill of the Association is so drawn as to give any locality

and any trade the benefit in lower contributions of any reduction in sickness rates which may be achieved, thus creating an immediate financial motive to reduce illness.

Just as employers have installed safeguards for dangerous machinery in order to reduce the cost of workmen's compensation, so in order to reduce the cost of health insurance they will supply, for instance, better sanitation, ventilation, and lighting, more physiological hours of labor, and fuller consideration for the special needs of employed women and children. In localities where the employer provides tenements for his workmen, he will be led to study and improve housing conditions. So-called welfare work will be made more effective and helpful. Employers will collect facts and statistics as to sickness, analyze them and apply such corrections as the facts discovered indicate. Dr. Rubinow states that a large corporation after introducing health insurance tried, for the first time, to discover its sickness rate and found it to be three times what is usual. Further investigation showed that this excessive rate was due to bad conditions, not in the factory, but in the sanitation of the city. As a consequence an effort was made for the first time toward improving these conditions. It is especially to be expected that as soon as employers realize the nerve strain caused by over-long hours and consequent increase of illness and, therefore, the cost to themselves, they will acquaint themselves with the effects of long hours of labor and reduce them.

The employee, on the other hand, will be likewise stimulated to welcome and to utilize factory hygiene, and improve his own domestic hygiene and individual hygiene. If there could be any doubt as to the reality or strength of this impulse it would vanish after observing the experience in Connecticut of the employees' relief associations organized to combat tuberculosis. Each workman contributes at least 25 cents and, as a consequence of that investment, takes a surprising interest in seeing that his money is wisely expended and that tuberculosis cases are promptly discovered and sent away for treatment. The possibilities of self-improvement through learning how to live are far beyond what any one who has not gone over the evidence realizes. The evils of bad air, bad food, imperfect teeth, wrong posture, improper clothing, constipation, self-drugging, alcoholism, etc., are now overlooked by ninety-nine workmen out of a hundred. Here is a wonderful opportunity for effective and intelligent leadership among committees of wage-earners. The employee will be more ready to apply to his own internal machinery a principle, long since applied by his employer to inanimate machinery, the principle of inspection and repairs.

After health insurance has been adopted slight impairments to health will be remedied before they become serious.

At present we find the United States, in striking contrast to health insured Europe, is suffering from an increase of the death rate after middle life. The increase consists of an increase in degenerative or wear-and-tear diseases, and is due to the growing neglect of personal and other hygiene. The death rate from degenerative diseases in the United States registration area has increased 41 per cent in twenty years.

One important effect of such attention to the health of the workman will be the prolongation of his life and especially of its earning period. Fewer workingmen will be thrown on the scrap heap in their forties with all the tragic consequences involved to their families as well as to themselves.

Moreover, the cash benefit gives the workman a better chance for recovery as well as a more perfect recovery if attained; for, to the poor, the obstacles to recovery are largely economic—insufficient food or other necessaries, worry over making both ends meet, and the consequent necessity of a premature return to work while still half-sick. It is found that the longer the time given up to sickness, which means the more care given to get well, the lower the death rate. Critics of German insurance have pointed to the fact that the number of days' absence from work per person on account of illness has increased under health insurance, but as Dr. Rubinow points out, this increase is partly, if not wholly, due to improved and longer care of the sick. Only part, and probably a small part, can be charged up to malingering.

Again, under compulsory health insurance both employer and employee will cooperate with the general public in securing public water supply, better sewerage systems, better milk, meat, and food laws, better school hygiene, more playgrounds and parks, and proper regulation of liquor and other health destroying businesses.

Health insurance will also, as it did in Germany, help to meet the crying need for rural sanitation and bring adequate medical and housing care to American farmers and their families.

Health insurance will operate, as it did in Germany, to stimulate the general scientific study of disease prevention, the future possibilities of which though unknown are, we may be sure, enormous. A German observer states that social insurance led to new knowledge in the field of occupational diseases, epidemics, and accidents. Dr. Lee K. Frankel, now of the Metropolitan Life Insurance Company, said at one time that "German insurance legis-

lation has been effective in producing a comprehensive industrial hygiene." Dr. Bielefeldt, quoted by Frederick L. Hoffman, says:

> The conviction may be expressed, after the experience of several years, that an effective battle against consumption among the working classes would have been all but impossible without the workmen's insurance of the German empire, and, by the support of their powerful pecuniary resources and with the aid of national social regulations, in the end we are quite certain to be victorious.

In Great Britain the health insurance act has led to education on the prevention and treatment of tuberculosis, many of the insurance committees having arranged for lectures, moving picture shows, and other means of educating the public.

I venture to predict that medical and hygienic discoveries and applications will be far more rapid in the future than in the past. What directions these discoveries will take can only be guessed. I expect, however, that a new field will be found in what may be termed industrial psychiatry, the development of which will not only diminish definite diseases but will also diminish industrial discontent and give back to the workman what the economic division of labor has taken away from him—a real interest in his work. The studies of a few of us in economics, particularly Professor Carl Parker of the University of California, and a few in industry, particularly Mr. Robert B. Wolf of the Burgess Sulphite Fiber Company of Berlin, New Hampshire, have led to the conclusion that a fundamental, perhaps the fundamental, cause of industrial unrest is to be found in the fact that most workers at present cannot in their daily tasks satisfy the fundamental human instinct of workmanship. At present many, if not most, workmen are interested only in their pay envelopes. I anticipate that, within a few years, under proper stimulus, psychiatrists will be able to show employers how to make jobs interesting, through a system which enables the workman to understand and keep a record of the results of his efforts and to receive credit for them in the eyes of his fellow workers, his employer, and himself. What little experience is as yet available points to the conclusion that devices for securing a genuine enthusiasm for the job mean much more than any system of scientific management for the health and happiness of the employee, for industry, and for industrial peace.

Besides health insurance many other stimuli of course exist, but they need reenforcement. Moreover, nothing can equal health insurance as a stimulus to prevention among employers and employees.

But prevention of disease and disability is not the only prevention to be effected by health insurance. It will indirectly but powerfully tend to reduce poverty. In the first place the simple operation of the indemnity principle itself tends to reduce poverty. Poverty to-day is largely mischance. When a poor man becomes sick, unless he can tide the emergency over by insurance or otherwise, he runs the risk of getting "down and out," for he has little or no margin. Without health insurance a vast number sooner or later exhaust whatever margin they have and sink into poverty—a land from whose bourne few travellers return. Students of gambling condemn games of chance because sooner or later most gamblers must lose enough to throw them out of the game. At present the American workmen without health insurance are gambling with their livelihood and in millions of cases are sure to be thrown out of the game. It is not a question of *average* well-being but of the numbers diverging from the average. One opponent of health insurance says it is not needed in America because the "average" American workman is comfortably situated. Aside from the fact that the most comfortably situated workman needs health insurance, we must not forget that the majority of workmen have less than the average wages and that a large minority have more than the average sickness (of a little over a week) per year. It is true that American wages are, on the average, much higher than German wages, but poverty is, or was before the war, markedly less in Germany than in the United States. This is doubtless largely if not chiefly owing to health insurance. The German laborer has not been allowed to gamble with disease and let it often win away from him his little all. In America, where the workingman is not so protected, we see the results in the casual laborer. Warren and Sydenstricker's *Health Insurance,* already referred to, states:

> The casual laborers at the docks in New York City are composed largely of workers who have gradually lost their economic status in industry, and the dock worker continues to slip down in the industrial scale until he reaches the class of "shenagoes," the down-and-out longshoremen who are capable of only light work and who finally become burdens upon public and private charity. According to testimony before the United States Commission on Industrial Relations, most of the 7,000 applicants for work at the San Francisco Cooperative Employment Bureau were of the casual labor class, and one-half of the total number of applicants were found to be incapacitated for work on account of poor nutrition, disease and exposure. The records of many investigators of the unemployed abound with similar instances.

Frederick Almy states:

> In Buffalo sickness is more serious in our work for the poor than anything else. It far exceeds unemployment as a cause of poverty. Last winter, 1914-1915, for instance, when the industrial depression was so high, we paid out $13,646 on account of unemployment, and $29,275, or more than twice as much, to families in which there had been sickness during the year.

Again, the Charity Organization Society of Buffalo reported in 1916 that "Last year in Buffalo less than 1 per cent of our poverty was due to lack of work, and more than 76 per cent to sickness." According to an officer of the United States Public Health Service, assigned to the Commission on Industrial Relations, sickness produces seven times as much destitution as industrial accidents. Dr. Devine found among 5,000 families known to the Charity Organization Society that in 75 per cent illness was a part cause of poverty. The report of the Immigration Commission of 1909 states that "The illness of the breadwinner or other members of the family was 'the apparent cause of need' in 38.3 per cent of the cases, while accidents were a factor in but 3.8 per cent of the total applications for aid." "At the New York legislative hearing on the health insurance bill in 1916 it was shown that 37 per cent of the families assisted by the New York Charity Organization Society are dependent because their wage-earners are disabled by sickness, while two-thirds to four-fifths of the expenditure of the New York Association for Improving the Condition of the Poor is for relief necessary because of illness." In the report of the New York Factory Investigating Commission (1915), one working woman gives it as her experience that "practically every week, in her factory, there is either a collection or raffle for the benefit of some worker who is sick, who has no resources, and who therefore is an object of the charity of her fellow employees." This custom, states the report, is really of considerable significance as an indication of how few are able to accumulate for times of emergency. It is also significant in showing how dire is the need of health insurance; for raffles and the like are a sort of stop-gap or make-shift for health insurance.

We see, then, that the claim that in America we do not need health insurance because the workman is so well-to-do is very evidently not in accord with the facts. As the *Brief for Health Insurance* of the American Association for Labor Legislation says, and as the above statistics would indicate, "America evidently presents no exception to the finding of Mr. and Mrs. Sidney Webb, that 'In all countries, at all ages, it is sickness to which the greatest bulk of destitution is immediately due.'"

Aside from the reduction of destitution, health insurance will tend to raise slightly the entire wage level. As Professor Moore of Columbia has shown in his *Laws of Wages* the wage level is fundamentally influenced by industrial productivity. Anything which raises the physical stamina of workmen increases their productivity and earning power. Thus the victims of hookworm disease in the South are poor, and constitute the "poor whites" because they are afflicted with the "germ of laziness," their power and inclination to work are crippled. The Life Extension Institute found that out of 2,000 workingmen and women over 99 per cent were below their normal working power, *i. e.,* were suffering from some condition or habit which subtracted from their efficiency. These minor impairments of health and efficiency are mostly preventable, and, in fact, in the group referred to, were in part prevented through the suggestions of the institute to the workingmen themselves.

Finally, we may expect health insurance to help forward industrial peace, for it will create machinery for continual conference between employers and employees.

We conclude that health insurance is needed in the United States in order to tide the workers over the grave emergencies incident to illness as well as in order to reduce illness itself, lengthen life, abate poverty, improve working power, raise the wage level, and diminish the causes of industrial discontent. It is not a panacea. It will not bring the millennium. But there is no other measure now before the public which equals the power of health insurance toward social regeneration.

THE PUBLIC HEALTH MOVEMENT

IRVING FISHER

The conservation movement is a movement to vent waste. When the Conservation Commission was appointed four years ago, emphasis was ced on the wastes of our natural resources, by the time the commission made its report had come to the conclusion that by far the st serious as well as the most preventable stes are the wastes of human life.

A generation ago it was a common impression t the average human lifetime was fixed as by decree of fate. When I was in college one of revered instructors showed us a mortality le, and said with great impressiveness: "There no law more hard and fast than the law of rtality." I believed it, and even yet many peo- are under this delusion. Pasteur did much introduce a more optimistic view. He stated belief in these immortal words, "It is within power of man to rid himself of every para- c disease." He staked this opinion on his own derful laboratory revelations as to germ life. lay we can confirm his words by absolute istics. And now his successor, Metchnikoff, surpassed even Pasteur in optimism. Metch- off is devoting himself to the prolongation of man life, and already gives us a vision of the e when centenarians will be regarded merely in the future of life and when the normal span of a century and a quarter will be a fre- t occurrence.

The growing consciousness that human life is a fixed allotment, which we must accept as doom, but a variable, which is within our ver to control, has recently led to extraordi- y exertions all over the world to save human . This impulse has gained strength also from great and almost universal decline in the h rate. Old countries like France and new ntries like Australia are confronted with the ter of depopulation. Consequently, as hu- n life becomes scarce, it becomes precious— l any other commodity! These two facts, the sciousness that much mortality is preventable, at any rate, postponable, and the fact that easingly fewer babies are being born in the ld, are together operating to produce a great th movement throughout the world. Noth- will stop it until the whole world is convinced he paramount importance of this problem of man conservation.

his world-wide movement for the conserva- of human life has expressed itself in many s—in medical research; in societies for pre- ing tuberculosis, infant mortality, social dis- s, alcoholism, and vice; in the growth of toria, dispensaries, hospitals and other insti- ns; in an immense output of hygienic litera- , not only technical books and journals, but popular articles in the magazines and daily spapers; in the constant agitation and legis- n for purer foods, milk supply, meat supply water supply; in the movement to limit the r of women and children and to improve factory sanitation; in the establishment of social insurance in Germany, England, Denmark and other countries; in the improvement of Departments of Health; in the spread of gymnastics, physical training and school hygiene; in the revival of the Olympic games and the effort to revive the old Greek ideals of physical perfection and beauty, and last and most important, in the sudden development of the science of eugenics.

In the summer of 1911 there was held in Dresden a unique world's fair, devoted exclusively to health—the International Hygiene Exhibition. In this were shown the fruits of the whole movement in all lands—except, alas, our own; for to our shame it must be said that we as yet are among the backward nations in this movement for the conservation of human life. Our Congress was asked to appropriate $60,000 to erect a building and supply an exhibit to show what we have done for our part in this movement, but Congress thought it could not afford so large an expenditure for so small (!) an object, and the result was that from the millions of people who visited this exhibition one constantly heard the question asked: "Where is the United States?"

And those few Americans who did go to visit the exhibition found that other nations had far outstripped us in this movement for national sanitation and health. Some of the achievements already attained by other nations should be recorded among the wonders of the world. One is the striking decline of the death rate in the city of London. Within two decades London's death rate has virtually been cut in two, and is now only thirteen per thousand, or less than that of most cities one-fiftieth its size.

Probably, however, the greatest achievement of any country is that of Sweden, where the duration of life is the longest, the mortality the least, and the improvements the most general. There alone can it be said that the chances of life have been improved for all ages of life. Infancy, middle age and old age today show a lower mortality in Sweden than in times past, while in other countries, including the United States, although we can boast of some reduction in infant mortality, the mortality after middle age is growing worse, and the innate vitality of the people is, in all probability, deteriorating. The reason why Sweden of all countries has succeeded in improving the vitality of middle age and old age, while other nations have failed, is, I believe, to be found in the fact that Sweden, of all nations, has seen the problem of human hygiene as a whole instead of partially. In most other lands, and particularly in the United States, public health has been regarded almost exclusively as a matter of protection against germs; but protection against germs, while effective in defending us from plague and other epidemics of acute diseases, is almost powerless to prevent

the chronic diseases of middle and late life. These maladies—Bright's disease, heart disease, nervous breakdowns—are due primarily to unhygienic personal habits. Medical inspection and instruction in schools, as well as Swedish gymnastics, have aided greatly in the muscular development of the citizens of Sweden. Swedish hard bread has preserved their teeth. The Gothenburg system is gradually weaning them from alcohol. There has even been a strong movement against the use of tobacco. Other countries are tardily following in the path which Sweden has trod so successfully.

The significant fact is that Sweden has not hesitated to attack the problem of personal habits. I believe we must have a revolution in the habits of living in the community if we are going really to realize the promise of Metchnikoff and others as to the prolongation of human life. Health officers in this country have not regarded it as a part of their duty either to live personally a clean, hygienic life, or to teach others to do so, or even to investigate what those conditions of well being are which make for personal vitality.

I can remember, thirteen years ago, talking with a doctor in Colorado as to the habits of living of his patients. I said to him: "You tell me that tuberculosis is a house disease, and that the reason it exists is because people do not open their windows. Why, then, do you not tell your patients they must open their windows, or sleep out of doors?" He said, "I wouldn't dare to do that; I would lose my practice. They would think I was a crank, and meddling in their personal affairs." Today that battle has been largely won. Today, not only in Colorado and California, and in the places where there is perpetual sunshine, sleeping out of doors is common and not confined to invalids, but is indulged in by the community generally. Even in New England and throughout the country you will find sleeping balconies going up all over. The change has even affected in some degree the architecture of the country, and while as yet only a minority of the people sleep out of doors, yet I believe it is true that the majority of the people in the United States have far more air in their sleeping and living rooms today than ten years ago. The fact which the doctor in Colorado did not dare tell his patients thirteen years ago has in some way been told to the people of the United States.

But there are many other things that need to be told, after we are sure that they are true. When we have, through our national, state or municipal officers, made thorough investigations and have been able to discover the actual truth as regards eating and drinking, hours of work, recreation and play—all those facts that go into what may be called personal habits—then we may gradually overturn existing unhygienic habits of living. John Burns attributes a large part of the great reduction in London mortality to the improved personal habits of working men, particularly in regard to alcohol. In this country Dr. Evans, both as health officer of Chicago and later as health editor of a Chicago newspaper, has shown how public instruction in personal habits can be made effective, and it will b largely through affecting personal habits that th life insurance companies will improve the longev ity of their policy-holders.

Scientific men today have reached substanti agreement that alcohol is a poison. When every body understands this, the days of alcohol as beverage will be numbered. Sweden in the 30 was called drunken Sweden, but today the ant alcohol movement there has converted Swed into one of the soberest of countries.

But the use of tobacco, tea and coffee ough also to be investigated, so that we may kno how far they are deleterious, and to spread th knowledge among the people.

Fashions are in their essence changeable, ar the time will come when the world will not l built on fashion, but on reason. Japan has mad more rapid progress in civilization than an other nation—because the late Mikado resolv and publicly stated that the institutions of Japa must not be tied by tradition, but must be base on reason. When we have replaced traditio by reason, we shall have gotten a solid basis fo civilization, and this must apply to ancient cu toms and habits of every kind. I am firmly co vinced that we are looking at only one-half o this public health movement as long as we co fine ourselves to the acute or infectious di eases. We shall not get more than half the r sults obtainable until we realize that there mu be a revolution in the personal habits of th people.

Yet the United States, in spite of its shortcom ings, has some special triumphs to record. W have, through hygiene under Colonel Gorga made it possible to dig the Panama Canal. W have virtually abolished yellow fever on o shores and in Cuba. We have nearly eliminat hookworm disease in Porto Rico and are grad ally doing the same in the southern states. W have found a remedy for one form of spin meningitis. We have, in New York, made object lesson in the last year of reducing th summer death rate of infants in a striking ma ner. We have, by individual milk stations Boston and other cities and in individual san toria, dispensaries and other institutions, demo strated that the death rate from specific diseas can often be cut in two.

Yet we have depended altogether too much private initiative. In New York the summ death rate of infants was reduced chie through the work of the milk committee a individuals like Nathan Straus. The discove of the wide prevalence of hookworm disease a the discovery of the serum for spinal meningi came through the gifts of Mr. Rockefeller. is well that individuals should apply themselv to these problems, and without such personal i terest they could never be solved. Neverthele progress will be many times as rapid when problems for the nation are managed in tional way. There are three great agenci which we must look for the saving of human l in the future, and it has been the object of t Committee of One Hundred on National Hea of which I am president, to help stir these th

agencies into activity in this country. They are the public press, the insurance companies and the government.

To a limited extent, all these agencies have increased their health activities in recent years. A few years ago popular articles on public health were seldom seen, because the public and the press thought the subject of disease uninteresting and repulsive. Today, on the other hand, one can scarcely pick up a popular magazine without finding not only one, but several, articles dealing with questions of public health; and it has been found possible not only to make these articles interesting, but, by emphasizing the positive or health side, instead of the negative or disease side, to render them attractive and beautiful. And yet, as Dr. Wiley has said, the newspapers, in spite of all the good they are doing with their right hands, are, with their left hands, in their advertising columns trying to undo that good by advertising the fraudulent part of the "healing" profession who are trying to line their own pockets at the expense of the lives of the public.

The second great agency from which, I believe, we may expect wonderful results in the future is life insurance. As our committee pointed out to the association of life insurance presidents several years ago, life insurance companies can save money by preventing deaths just as fire insurance companies have saved money by preventing fires, and steam boiler insurance companies have saved money by preventing explosions. Since this suggestion was made a number of progressive life insurance companies have tried the experiment. The Metropolitan and the Equitable have established departments of human conservation, and a number of other and smaller companies have undertaken similar enterprises. The Postal Life Insurance Company has recently published the statistical results of their experience, worked out in a most careful manner, and has demonstrated absolutely that it pays life insurance companies to save human life. This being the case, we may expect life insurance companies in the future to become active in life conservation. Already there are probably fifteen million policyholders in the United States insured in companies which are trying to do something for their health—through medical examinations, instruction in hygiene, utilization of visiting nurses, participation in civic health movements and otherwise. To save human life merely to save money is sordid enough, but it is well to harness commercial motives, when possible, in the service of humanity.

The third and most important agency is the government. State and national health offices are becoming yearly stronger and more efficient; but yet much remains to be done, particularly by the national government. We need a national department of health or a department of labor which shall include in its operations the conservation of human life. We have already passed the phosphorus match bill to prevent one of the worst industrial diseases—phossy jaw. We have passed effective legislation in regard to interstate commerce in prostitution. We have established a Children's Bureau, and a Bureau of Mines to prevent industrial accidents in mining. We have enacted suitable legislation in regard to cocaine and habit-forming drugs. We have a Pure Food Law and laws for the inspection of meats. Yet, as Dr. Wiley, Mrs. Crane and others who have watched the operation of these laws at close range well know, they need to be executed with a stronger hand.

The truth is that as yet we have only made a feeble beginning in public health work, especially in this country. We need, first of all, to do what Sweden has done for a hundred and fifty years—namely, to keep proper vital statistics. Vital statistics are the bookkeeping of health, and we cannot economize health any more successfully than we can economize money unless we keep books. At present only a little over half of the population of the United States has statistics of its deaths, while the statistics of the births are as yet nowhere sufficiently accurate to be called real statistics.

Our national statistician, Dr. Wilbur, illustrates by a story how much better we keep our commercial books than our books of vital statistics. In a western state a girl was entitled to a fortune when she became twenty-one. Reaching, as she supposed, her twenty-first birthday, she laid claim to the fortune. Much to her surprise, her father said: "But you are only nineteen"; and then the two tried to look up the records. They had no family Bible, they had no public record office to go to, and they were at sea as to how to discover exactly the date when she was born. However, it suddenly occurred to her father, who was a farmer, that on the very day his daughter was born a calf was born on his farm, and the birth of the calf had been recorded. In that way he established the date of the birth of his daughter.

In view of the great lack of our vital statistics, therefore, we cannot measure even the death rate, much less the number of preventable deaths in the United States. All that we can do is to study carefully the registration area, and on this basis to work out certain minimum figures.

Four years ago, as a member of President Roosevelt's Conservation Commission, I endeavored to do this and to report on the condition of our "national vitality." I found, after getting together all the statistics available and taking account of the degree of preventability of different diseases as estimated by experts, that out of some 1,500,000 deaths annually in the United States at least 630,000 are preventable! Of these preventable deaths the greater number are from seven causes. These seven causes include three great diseases of infancy; then typhoid fever, which usually makes its attack in the twenties; then tuberculosis, accidents in industry, and pneumonia, which come in the thirties.

Now 630,000 unnecessary deaths per year mean over 1,700 unnecessary deaths per day, or more than the lives lost in the Titanic disaster! The nation cannot continue indifferent to hygiene as it gradually dawns on the public that for lack of hygiene we suffer a Titanic disaster every day of the year. The popular imagination was

deeply stirred by the image of 1,600 helpless human beings suddenly engulfed in midocean. That was a vivid dramatic picture which the blindest of men could see and understand. It led to immediate official action on both sides of the Atlantic to safeguard human life at sea. Yet on land we lose 365 times as many lives as this every year, and never stop to add it up! They are scattered and diffused throughout the land—a Wilbur Wright lost from typhoid, a handful of miners in an explosion, some railway employes in an accident, some victims of lead poisoning, a little army of infants, here a few men and there a few. Yet these deaths are just as real and mean an infinitely more serious loss than the deaths from the Titanic disaster. Moreover, they could be as easily prevented.

And concomitant with this unnecessarily great death rate there is, of course, a colossal aggregate of needless sickness. We have no real statistics, but by analogy with English statistics we may assume that, on the average, for every death per annum there are two persons sick during the year. This makes about 3,000,000 people constantly lying on sick beds in the United States, of which, on the most conservative estimate, at least half need not have been there.

If, now, on the basis of these figures, we try to compute how much human life is needlessly shortened in the United States, we find that it is shortened at least fifteen years. Again, if we translate these preventable losses into commercial terms we find that, even by the most conservative reckoning, this country is losing over $2,000,000,000 worth of wealth-producing power every year.

What does this mean? To us individually it means that we are losing a large part of our rightful life not only by death itself, which cuts off many years we might have lived, but also from diseases and disabilities which are not fatal but cripple the power to work and mar the joy of living. I believe I am far within the facts when I venture the opinion that the average man or woman in the United States is not doing half of the work nor having half of the joy of work of which the human being is capable.

With all this room for improvement before our eyes, it is not surprising that the zeal of the health movement is growing fast. Each success serves as justification for further effort.

One of the most encouraging symptoms of progress is the great attention which was paid to public health in the recent political campaign. All three of the party platforms included planks in behalf of public health. The Democratic and Progressive platforms were particularly explicit and emphatic, and all the candidates have emphasized health in speeches and in their record in public life.

These and other indications augur well for better legislation, more energetic enforcement of the law and, above all, a more appreciative public sentiment as to the transcendent importance of the conservation of human life. It is now reported that Dr. Roche, secretary of state Canada, is in strong sympathy with the propos there for the establishment of a Federal Depar ment of Health, and the Republic of China reported to have already established such a d partment.

From all these indications of actual activit as well as from the logic of the situation, w are justified in predicting that an age of huma conservation is at hand. Men and women a waking to their responsibility to the race. E genics will be a watchword of the future. squander our natural resources is ignoble i deed, but far worse is it to squander our vit resources. The most sacred obligation of ea generation is to bequeath its life capital unir paired to the generation which comes aft Scourges like typhoid and tuberculosis must swept off the face of the earth. Habit-formin drugs, including alcohol (and even tobacco, esp cially for young boys), must be recognized their true light as means of depleting the vitali of nations. Prostitution and the white sla traffic must be condemned anew as robbers the race. Industries which kill and maim, pois or infect their workers, which deform and stu little children, which incapacitate women for nc mal motherhood, which through overlong hou of toil close each successive day's work with pr gressive exhaustion, must be controlled. M chinery was made for man, not man for machi ery. Marriage laws and customs must be a justed so as to discourage or forbid the procre tion by the unfit. All these and other hygie and eugenic reforms will be realized as fast public sentiment becomes educated to the soler responsibilities and higher valuations of hum life.

The noblest task, therefore, which I can co ceive for any man is to aid in erecting true ide of perfect manhood and womanhood. Our idea though improving, are not yet worthy to be co pared with those of Japan or Sweden, and t ideals even of these countries have not y reached the level of those of ancient Greece s imaged for us in imperishable marble. With s perior knowledge, our health ideals should ex those of any other age. These ideals should n stop with the mere negation of disease, dege eracy, delinquency and dependency. They shou be positive and progressive. They should inclu muscular development, a sound mind in a sou body, integrity of moral fiber, a sense of t splendor of the perfect human body as a tem of the human soul, a sense of the enjoyment all life's proper functions. As William Jam said, simply to breathe or move our musc should be a delight. The thoroughly healt person is full of joy and optimism. He rejoice like a strong man to run a race. Said Emerso "Give me health and a day, and I will mak pomp of emperors ridiculous!" Our health ide should be nothing short of an abiding sense the sweetness and beauty, the nobility and ness of human life.

THE "RATIO" CHART

For Plotting Statistics

By

PROFESSOR IRVING FISHER

Yale University

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THE "RATIO" CHART

For Plotting Statistics.

By Professor Irving Fisher, *Yale University.*

COMPARING TWO MAGNITUDES BY THEIR DIFFERENCE AND BY THEIR RATIO.

In the last few years there has been a great increase in the appreciation and use of statistical charts. As a consequence, a number of efforts have been made to improve the technique of graphic representation in order that the chart may convey its message more quickly, accurately, and unmistakably. Toward this end Mr. Willard C. Brinton in particular has put us all under obligation.*

In the present article, I shall describe the nature and advantages of one form of chart on which to plot a statistical curve,—by which is meant any curve or broken line showing the different numerical values of a statistical magnitude at different periods of time. This chart will be found of very great assistance when the only object or the chief object is to display and compare *ratios.* It may therefore be called the "ratio" chart.†

The chief reason why ratio charting has not yet been more widely used is, I believe, that its extreme simplicity is not yet realized. Those who have mentioned it in print have usually contented themselves with stating dogmatically how it is to be used without explaining the whys and wherefores, further than that its spacing is "logarithmic" like that of a logarithmic slide rule. But most persons regard logarithms and slide rules as a species of magic and fight shy of a method, the foundations of which they do not clearly understand.

*Through the publication of his "Graphic Methods for Presenting Facts," New York (The Engineering Magazine Company), 1914, 371 pp., and through the work of the Joint Committee on Standards for Graphic Representation which grew out of the publication of his book.

†I am not, as I originally supposed, the first to hit on this simple device, although it still remains almost wholly unknown and unused and has never yet, so far as I know, been adequately described. A bibliography of the very meagre literature on the subject is given at the end of this article. It is there shown that the method in essence was used as early as 1863.

The object of this article is to make the construction of the ratio chart clear to any reader and, at the same time, to point out in some detail its various uses and advantages. In doing this it is quite unnecessary to use even the concept of logarithms.

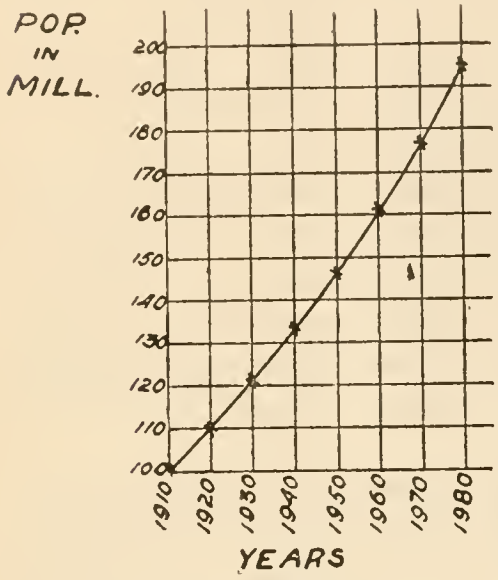

FIG. 1*d*. FUTURE HYPOTHETICAL POPULATION OF THE UNITED STATES. ORDINARY OR DIFFERENCE METHOD.

Equal vertical intervals represent equal statistical differences. A line in ascending at a uniform *ratio* is curved. Uniformity is therefore not evident to the eye.

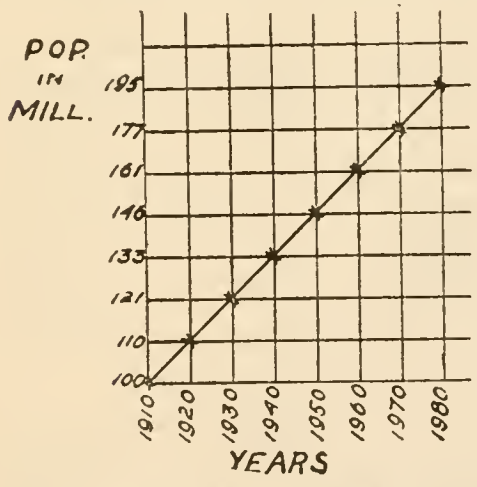

FIG. 1*r*. THE SAME. RATIO METHOD.

The same assumption. Uniformity is here evident to the eye, being represented by a straight line.

We may compare any two magnitudes, of like kind, by means either of their difference or of their ratio. In the first kind of comparison "an inch on the end of one's nose" is exactly as much as an inch added to the height of the Washington Monument; in the second kind of comparison, on the other hand, "an inch on the end of one's nose" is an addition of about 40 per cent., or as much as 220 feet added to the height of the Monument.

The ordinary chart is adapted to *difference* comparisons rather than to *ratio* comparisons, whereas the statistician is usually concerned with ratio comparisons far more than with difference comparisons.

CONVERTING ORDINARY PLOTTING PAPER.

Fig. 1 *d* ("d" standing for "difference") shows an ordinary plotting chart; that is, a chart with equal vertical spacing, labelled for population in millions, the labelling being for equal statistical *differences*, and each interval of verti-

cal ascent representing an increase of 10 millions over the preceding.

Since the key-idea of the ratio chart is that equal vertical intervals represent equal *ratios* of increase instead of equal differences of increase, it may also be constructed from ordinary cross ruled plotting paper. This may be done in two steps, (1) labelling the existing lines and (2) interpolating new lines. The first step is to label the existing (equidistant) horizontal lines with numbers increasing in a given ratio.

Fig. 1 *r* ("r" standing for "ratio"), shows a ratio chart made from ordinary ruled paper simply by labelling the horizontal lines for *ratios*, each interval of vertical ascent now representing an increase of 10 *per cent.* over the preceding. That is, while the first chart is labelled vertically, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, etc. (each number being 10 more than the one below) the second chart is labelled vertically, 100, 110, 121, 133, 146, 161, 177, 195, etc.* (each number being 10 *per cent.* more than the one below).

The ratio method consists simply in plotting any statistical curve by using the labels† of Fig. 1 *r* instead of those of Fig. 1 *d*.

Thus, let us plot, say, the (imaginary) population of the United States in millions, beginning with 100 millions in 1910 and assuming an increase of 10 per cent. every decade. Since all increases of 10 per cent. are represented in Fig. 1 *r* by equal vertical distances, it is clear that the curve representing population, *i. e.*, connecting the series of points in Fig. 1 *r* lying diagonally on the cross lines, will be a straight line.

Thus we see the first merit of the ratio method of charting the growth of a statistical magnitude: *uniformity* in the percentage rate of growth is pictured by *straightness* in the plotted line.

On the other hand, in the ordinary or difference chart, such as that of Fig. 1 *d*, the same population growth will be represented by an "exponential curve" and its uniformity of per-

*If we carry the numbers backward, that below 100 will be 91 (for 91:100::10:11); that next below 91 will be 83; and so on, indefinitely, down to any number, however small, except zero. Evidently we can approach as near to zero as we please but zero itself recedes into a bottomless pit; there is no base or zero line.

†Of course in the ratio chart as in the difference chart the numbering may be magnified or reduced in any ratio. Thus instead of the numbers 100, 110, 121, etc., we may substitute 1.00, 1.10 1.21 or .100, .110, .121, etc., etc.

centage rate of growth is altogether lost to the eye. In fact the uninitiated are apt to be misled and to falsely infer from such a curve that the rate of growth is increasing.

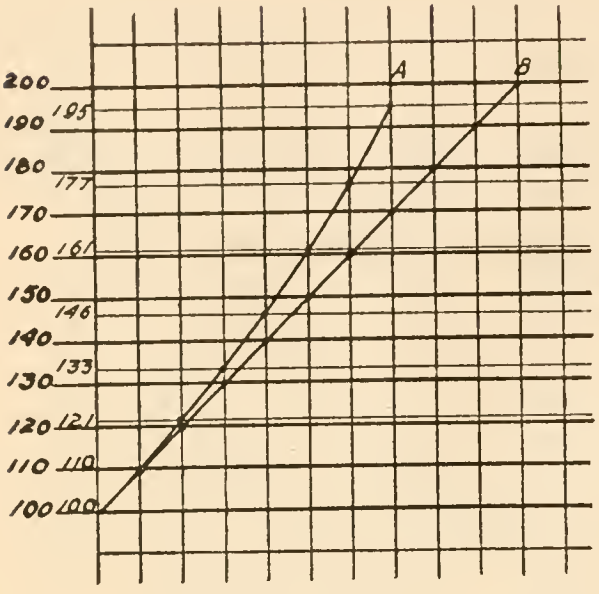

FIG. 2*d*. SHOWING GEOMETRICAL (A) AND ARITHMETICAL (B) PROGRESSIONS. DIFFERENCE METHOD.

A line (A) ascending at a uniform ratio in equal periods of time, that is, in geometrical progression is curved (upward). A line (B) ascending by equal differences in equal periods of time, that is, in arithmetical progression, is straight. Note that vertical intervals increasing in geometrical progression (see the light figures) are unequally spaced.

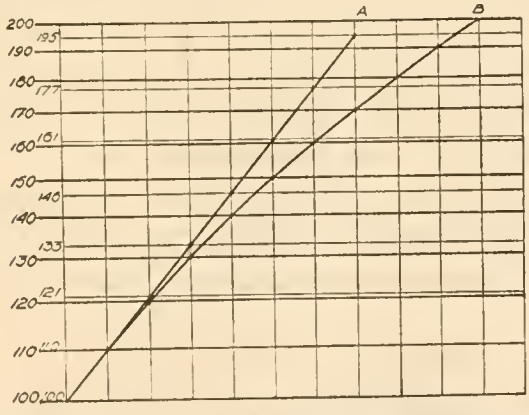

FIG. 2*r*. THE SAME. RATIO METHOD.

A line (A) ascending at a uniform ratio in equal periods of time, that is, in geometrical progression, is straight. A line (B) ascending by equal differences in equal periods of time, that is, in arithmetical progression, is curved (downward). Note that the vertical intervals increasing in geometrical progression (see the light figures) are equally spaced.

RERULING THE RATIO CHART SO OBTAINED.

But the ratio chart, as described above, is not very convenient for plotting points between the ruled lines, because so few of the labels are round numbers. To make a full fledged ratio chart, new horizontal lines need to be interpolated, at their proper places, corresponding to the round numbers 120, 130, 140, 150, etc. (Fig. 2 *r*) and the original equi-distant ones should be erased.* The contrast, then, be-

*Plotting paper for ratio charts may now be obtained ready-made from a few commercial firms, the Educational Exhibition Company, 26 Custom House Street, Providence, R. I., John Wenzel, 63 West 107th Street, New York City, Keuffel and Esser Company, 127 Fulton Street, New York City, and the Standard Graph Co., 32 Union Square, New York City.

The unequally spaced horizontal lines shown in Fig. 2 r become more and more crowded together as we ascend, until it becomes necessary, or advisable, to omit some of them. The omission of these lines causes the plotting paper to present the appearance of an intermittent or cyclical spacing (Fig. 3 *r*).

tween the ratio chart, and the ordinary, or difference, chart, is simply one of spacing, the ratio chart (as in Fig. 2 *r*) having the numbers 120, 130, 140, etc. *unequally* spaced whereas the difference chart (as in Fig. 2 *d*) has these same numbers *equally* spaced.

The above description of a method of forming a ratio chart

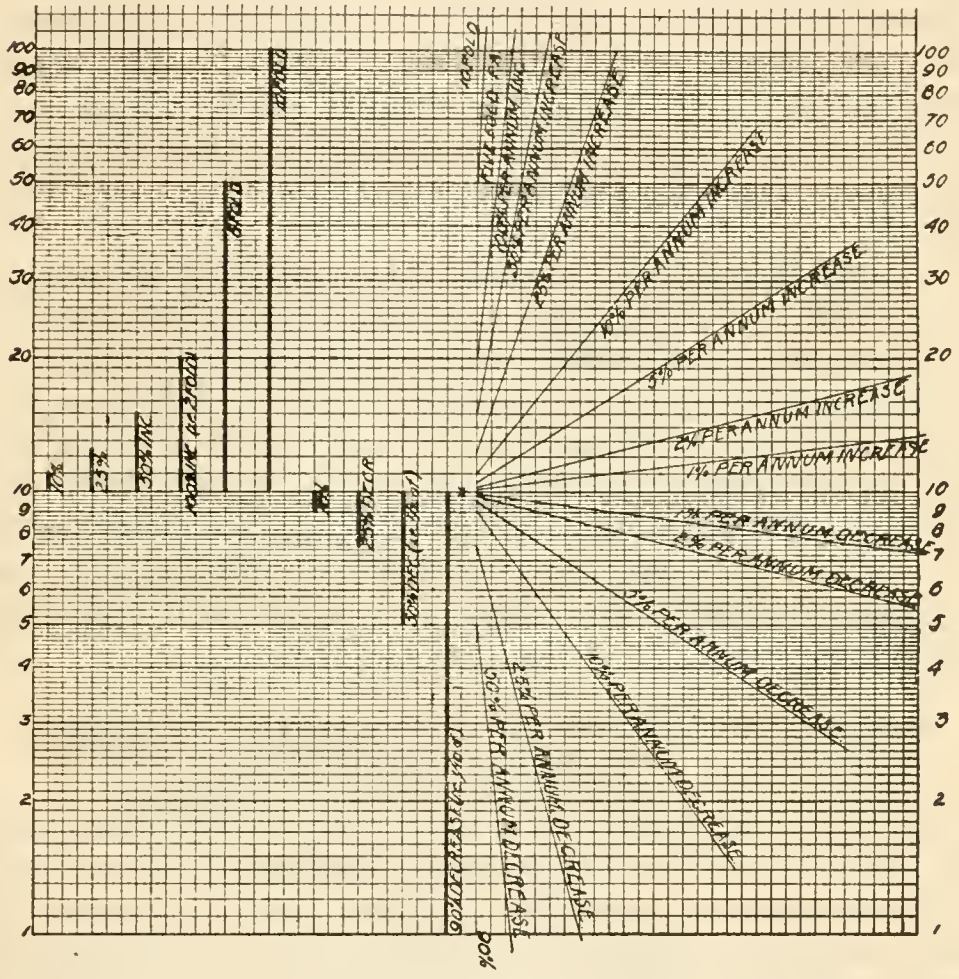

FIG. 3r. SCALES OF ELEVATIONS AND SLOPES. RATIO METHOD.

Showing, at the left, the elevations (and depressions), representing various ratios of increase (or decrease), and showing, at the right, the slopes representing various per annum rates of increase (or decrease).

will serve to explain its nature as representing equal successive percentages of increase by equal intervals on the chart.

In Fig. 3 *r* we see the full fledged ratio chart, constituting a ruling arrangement convenient for plotting. To familiarize the reader with the graphic representation of ratios, some dark vertical lines are drawn. These show how far up to go to

represent an increase respectively of 10, 25, 50, and 100 per cent. (or 2-fold), 5-fold and 10-fold; while the next lines to the right show how far down to go to represent a decrease of 10, 25, 50 (i.e. "half of"), and 90 per cent. Any two points on the chart, however far removed from each other horizontally, if the vertical interval between them is equal to the 10 per cent. line, will be such that the statistical magnitude represented by the upper point will be 10 per cent. greater than that represented by the lower. Again the line representing "100 per cent. increase or 2 fold" is the vertical distance between any two points on the chart of which the upper stands for twice the statistical number for which the lower stands.

The reader is advised to verify these and the other legends by taking any two points at random, reading the figures opposite them in the margin and comparing these figures.

He may also familiarize himself with the sloping lines at the right ascending respectively at the rates of 1, 2, 5, 10, 25, 50, 100 per cent. five fold, and ten fold per annum, as well as those descending at the rates of 1, 2, 5, 10, 25, 50, and 90 per cent. per annum, all drawn radiating from a center through the appropriate points on a vertical line one unit to the right of that center.

REPRESENTING GROWTH AT A CONSTANT, OR NEARLY CONSTANT, RATIO.

The advantages of the ratio chart over the difference chart are many. They may be seen from a few illustrative examples.

We have already seen (Fig. 1 *r*) that mere straightness of the plotted line indicates, in the ratio chart, a uniformity in the percentage rate of growth, whereas in the difference chart such uniformity is represented by an exponential curve (Fig. 1*d*).

In Fig. 2 *d* and Fig. 2 *r* the same lines are repeated and labelled *A*. The line *A* represents a uniform percentage rate of growth. It is an exponential curve in the difference chart (Fig. 2 *d*) and a straight line in the ratio chart (Fig. 2 *r*).

For contrast a straight line *B* is drawn on the difference chart (Fig. 2 *d*). Its straightness signifies little—merely that the same absolute difference is added each year. But the

same absolute difference is a decreasing percentage *rate* of growth and this fact is clearly interpreted in the ratio chart (Fig. 2 *r*). We may say that the chief or typical contrast between the two charts is that a straight line represents in the one an arithmetical progression and in the other a geometrical progression; which is only another way of saying that it

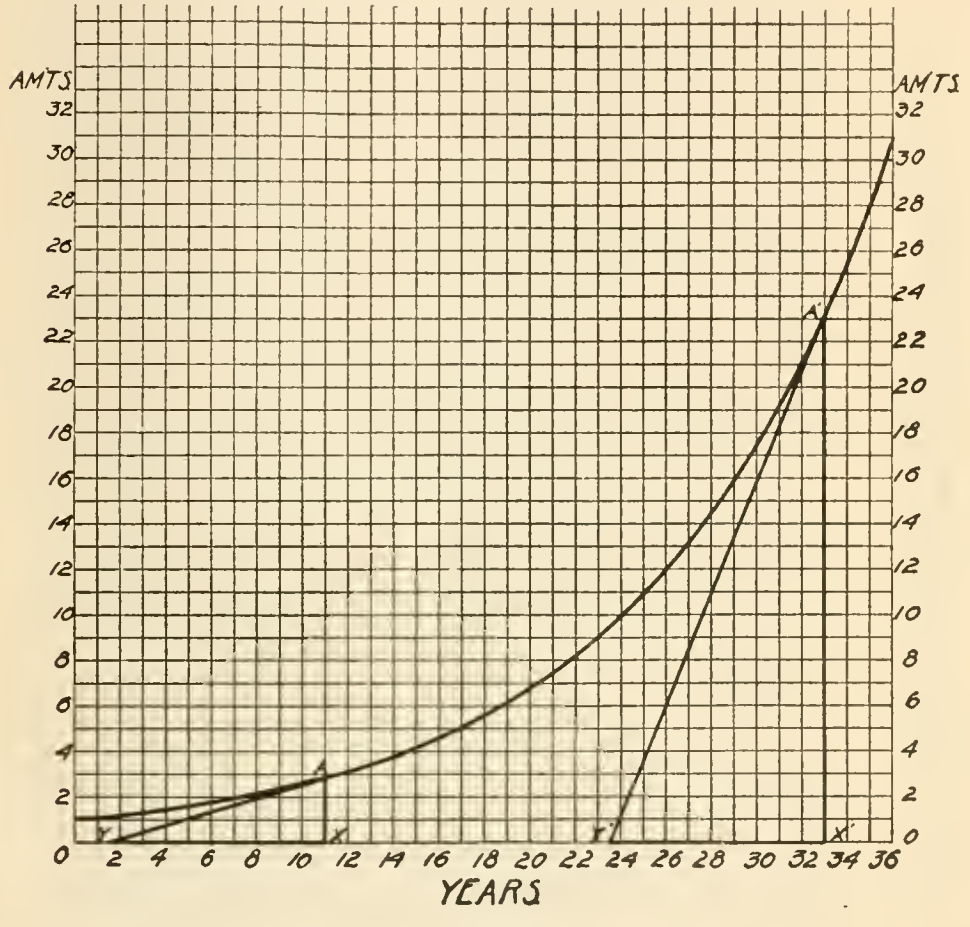

FIG. 4*d*. UNIFORM PERCENTAGE RATE. DIFFERENCE METHOD.
Showing uselessness of curve at extreme ends; also showing how to compare percentage slopes at different points by comparing (inversely) the subtangents for these points. See p. 596.

represents a progression by equal differences in the one and by equal ratios in the other.

A serious fault in the difference method is that, in a curve of rapid growth, the difference chart is useful only in the middle portion. At the extreme left such a curve, *e. g.*, an exponential, or uniform percentage, curve (as in Fig. 4 *d*) becomes almost indistinguishable from a horizontal line and at the extreme right it becomes almost indistinguishable from a vertical line.

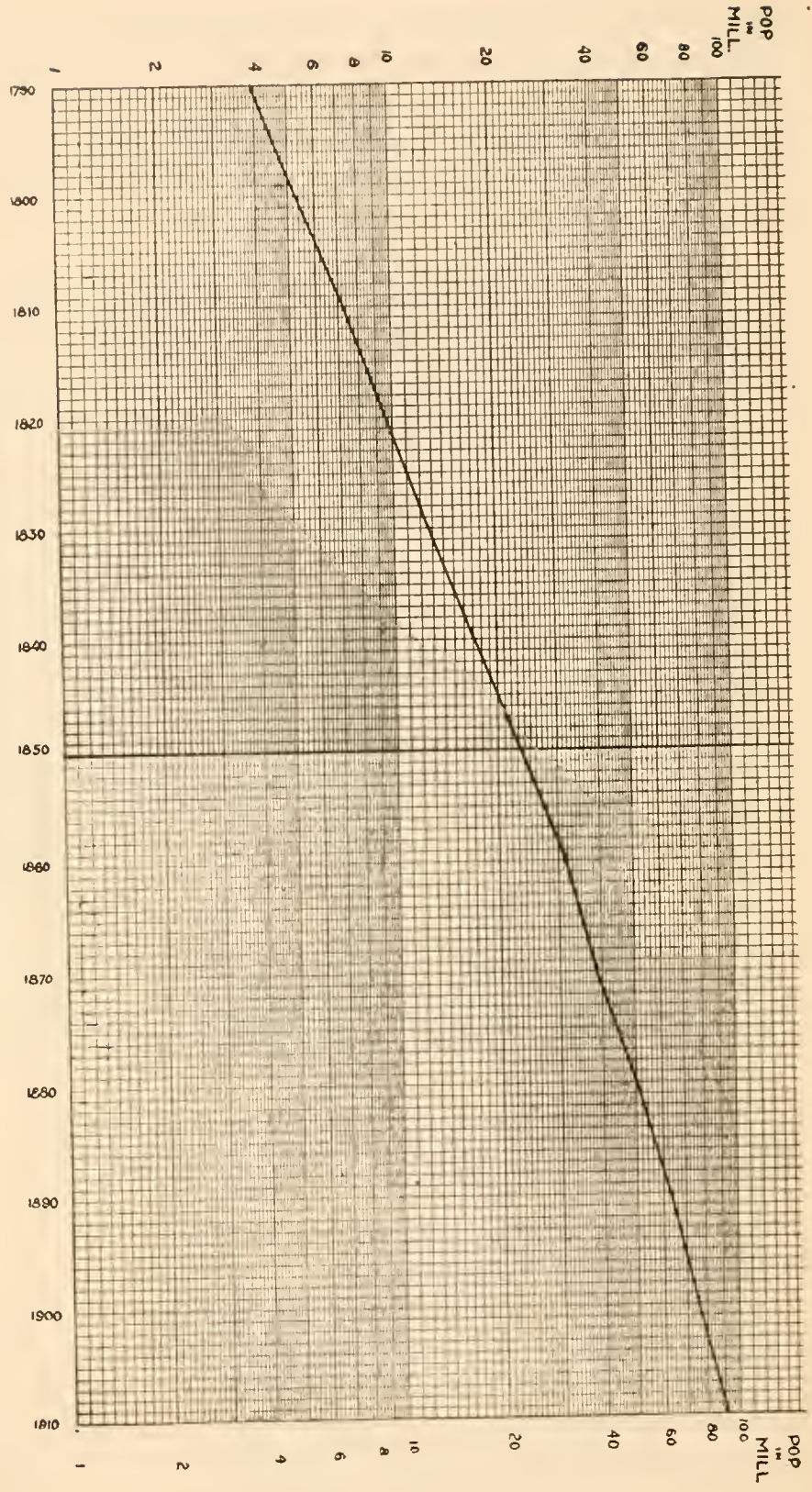

FIG. 5r. THE SAME. RATIO METHOD.

Showing clearly the slight deviations, since 1860, from a uniform rate of growth.

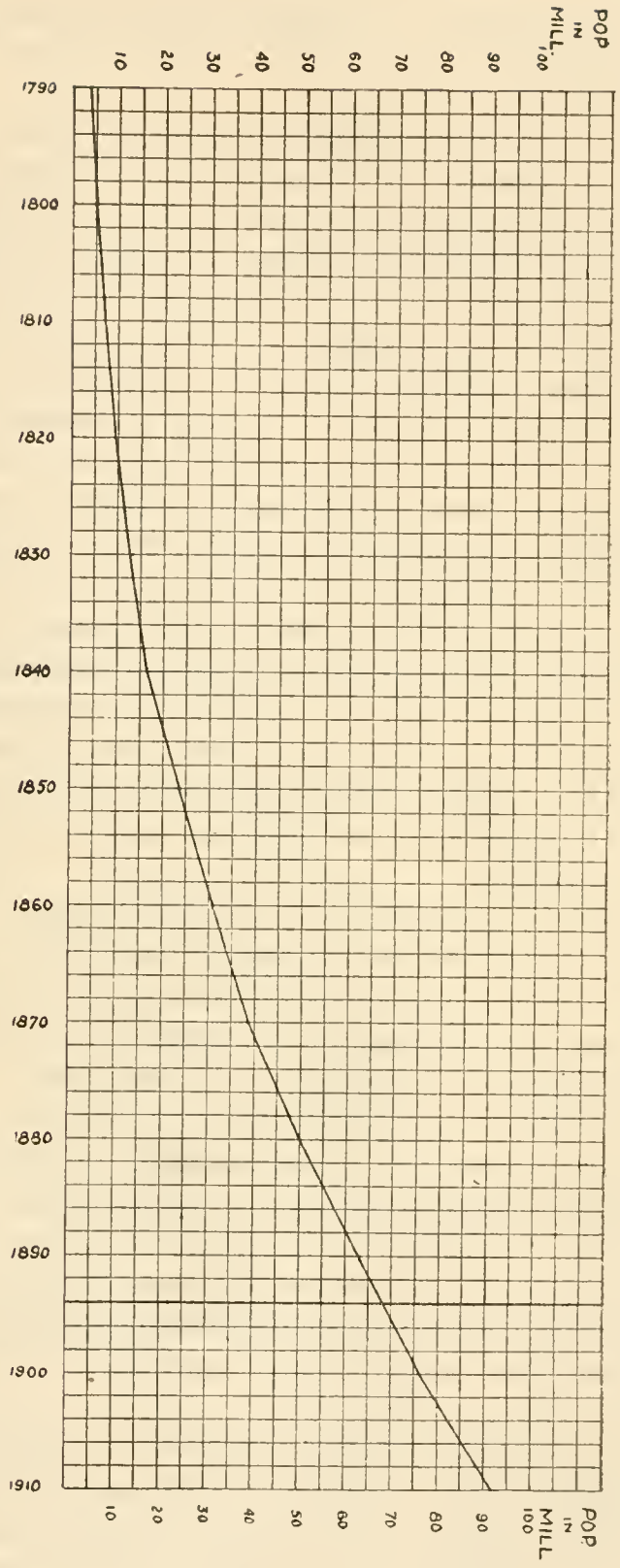

FIG. 5*d*. ACTUAL POPULATION OF THE UNITED STATES. DIFFERENCE METHOD.
Showing the impossibility of correctly comparing rates of increase at different periods.

At either extreme no eye can estimate the percentage rate of growth although that rate may not be different from the rate in the middle.

A vast number of statistical charts represent *rapid and long continued growth*,—the statistics of a prosperous business plotted from the beginning; the statistics of a growing country; the statistics of new inventions. We have merely to mention any such familiar examples as statistics of population, wealth, crops, mining, manufacturing, railway mileage, telephones, automobiles, bank deposits, new building, sales of stocks, war debts and other magnitudes rapidly increasing since the war began, in order to realize the thousands or rather, probably, the millions of statistical charts which have been constructed of this kind, most of which are nearly useless at either end.

Thus Fig. 5 *d* represents the actual growth of the population of the United States. The reader, however discerning or experienced, cannot discover by mere ocular inspection of this curve whether the increase at the end is faster or slower than at the beginning. Fig. 5 *r*, on the other hand, shows the facts desired at a glance. It shows a uniform rate of growth between 1790 and 1860 and slight but evident changes since the last named date.

One great advantage of the ratio chart is in forecasting. Usually, in business, we forecast by assuming a certain ratio of growth. In the ratio chart we have simply to draw a straight line; usually, in fact, merely to produce the one already drawn representing the rate experienced in the past.

One method by which users of the ordinary chart have attempted to meet its shortcomings in representing statistics of rapid growth is first to draw a "growth axis," or exponential curve [such as that in Fig. 1 *d*, Fig. 2 *d* (curve A), or Fig. 4 *d*] ascending at the *average* rate of growth of the statistics under consideration; then calculate the per cents. of deviation each year from this "growth axis"; and finally, plot these deviations on a separate chart.

This procedure, however, involves, in addition to charting the original statistical figures, much subsidiary calculation and charting; and the results, when obtained, are not as exact as the results obtainable more easily by the ratio method.

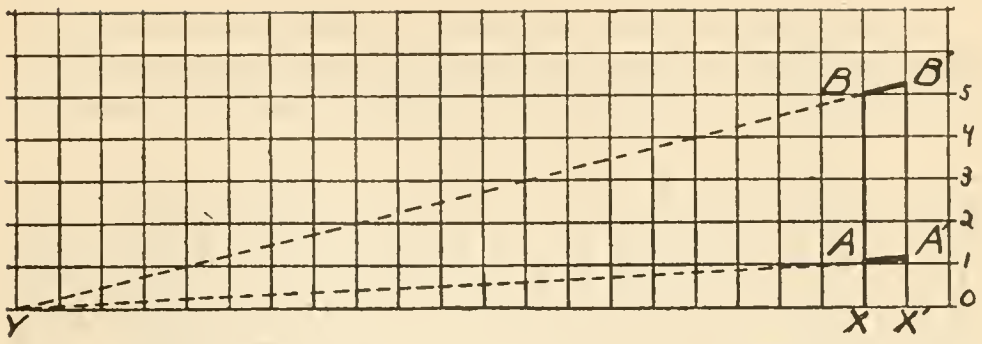

FIG. 6*d*. EQUAL RATES OF GROWTH APPARENTLY UNEQUAL. DIFFERENCE METHOD.
Segments of two curves ascending at equal rates but having unequal slopes and therefore deceiving the eye.

COMPARING CURVES.

If we wish to compare the growth of population in two countries of different sizes, such as Canada and the United States, the ordinary or difference plots, of which we shall assume that AA' and BB' in Fig. 6 *d* are small sections for a given year, will give the impression that the upper curve, *i. e.*, that for the larger country, is ascending at a much faster ratio than the lower, *i. e.*, that for the smaller country. Few would suspect that the two lines AA' and BB' represent precisely the same percentage rate of growth.

In Fig. 6 *r*, on the other hand, the equality of these same two rates of growth is clearly indicated by the parallelism of the two lines AA' and BB'.

Again, if the plots of the two populations appear as in Fig. 7 *d*, most persons, observing the parallelism of the two lines, would jump to the conclusion that the two populations are growing at the same percentage rate. The fact is that the lower line, AA', is ascending at a greater percentage rate than the upper, BB'. The ratio chart (Fig. 7 *r*) shows this at a glance.

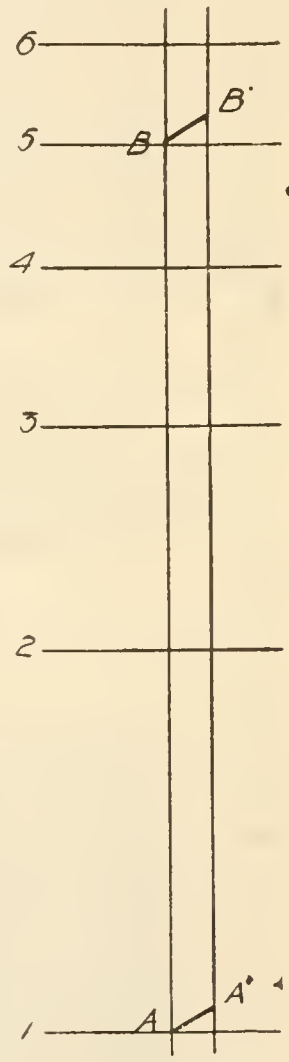

FIG. 6*r*. EQUAL RATES OF GROWTH EVIDENTLY EQUAL. RATIO METHOD.
The two segments are here parallel.

In the difference chart, in order to make even a rough eye-estimate of the comparative percentage rates of growth of AA' or BB' (Fig. 6 *d* or Fig. 7 *d*), we must: (1) note the position of

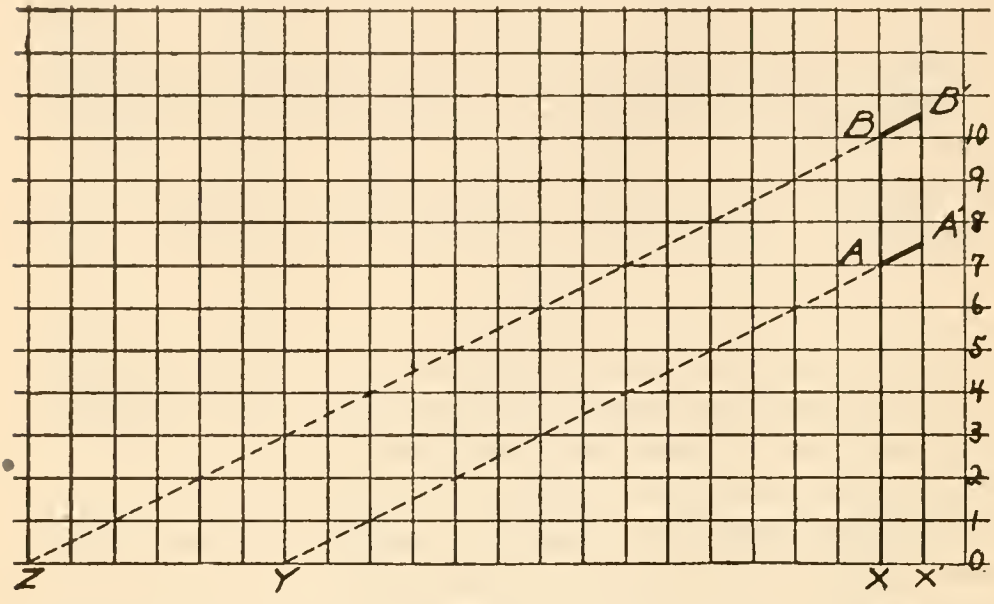

FIG. 7*d*. UNEQUAL RATES OF GROWTH APPARENTLY EQUAL. DIFFERENCE METHOD.
Segments of two curves ascending at equal slopes, but at unequal rates and therefore deceiving the eye.

the zero or base-line, XX'; (2) mentally compare $A'X'$ with AX and $B'X'$ with BX; and (3) compare the two comparisons.

Such mental operations are difficult, irksome, and inaccurate, especially if, as is not uncommon, the base or zero line has been omitted in order to economize space. Furthermore they involve shutting our eyes to the slope or steepness of the lines AA' and BB', the very feature which first attracts attention.

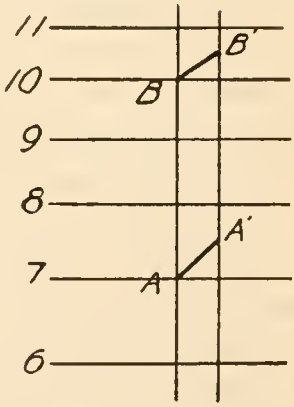

FIG. 7*r*. UNEQUAL RATES OF GROWTH EVIDENTLY UNEQUAL. RATIO METHOD.
The two segments are here of different slopes and the steeper slope indicates the greater rate of growth.

Often, in fact, the bottom part of the chart, containing the base line, is cut off, and sometimes, instead of using the same base line for two curves on the same chart the draughtsman will bring one curve nearer the other by using two separate base lines. In either event the result is misleading or confusing and in such cases it is almost hopeless to obtain any clear idea

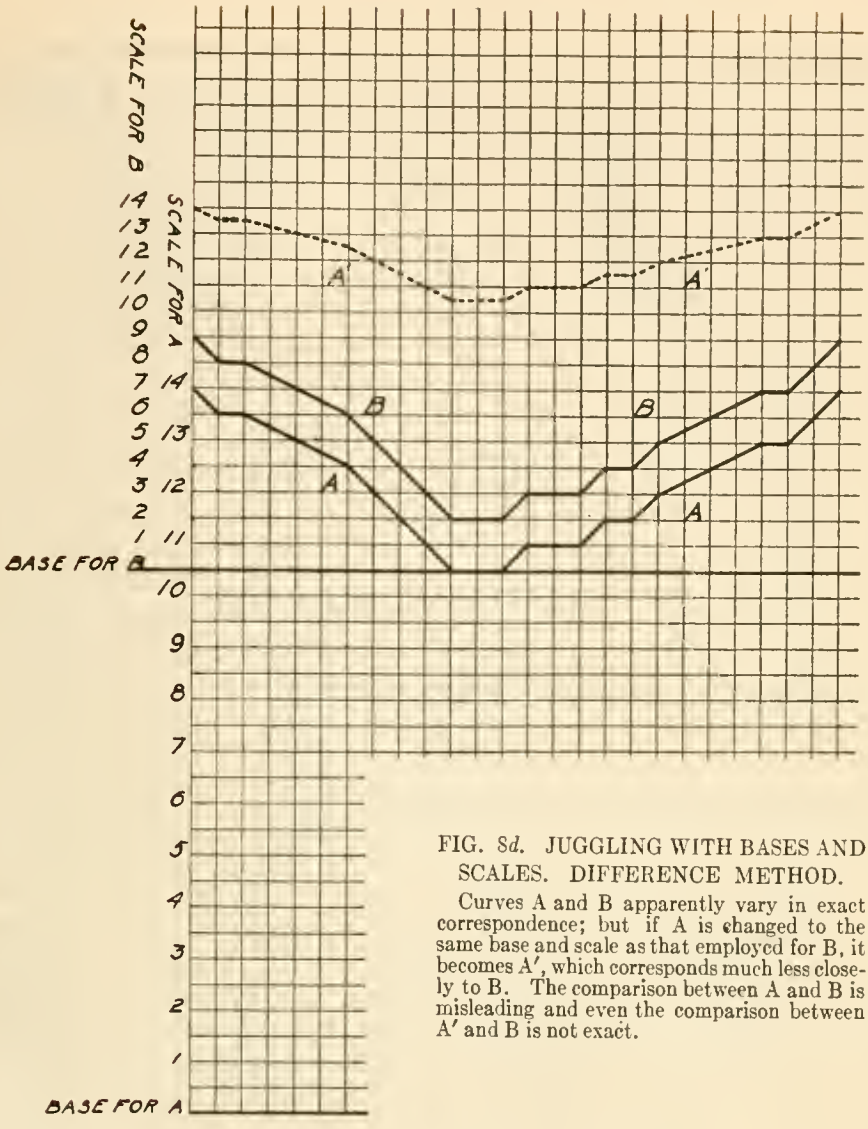

FIG. 8*d*. JUGGLING WITH BASES AND SCALES. DIFFERENCE METHOD.

Curves A and B apparently vary in exact correspondence; but if A is changed to the same base and scale as that employed for B, it becomes A′, which corresponds much less closely to B. The comparison between A and B is misleading and even the comparison between A′ and B is not exact.

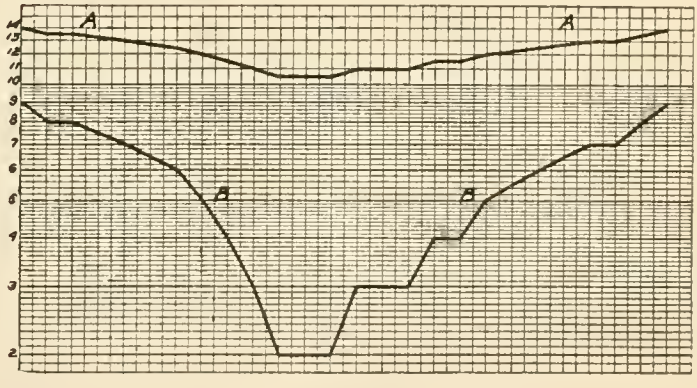

FIG. 8*r*. THE SAME. RATIO METHOD.

The comparison between A and B here exactly represents the facts, showing only a faint resemblance, in marked contrast with the first comparison in the preceding figure.

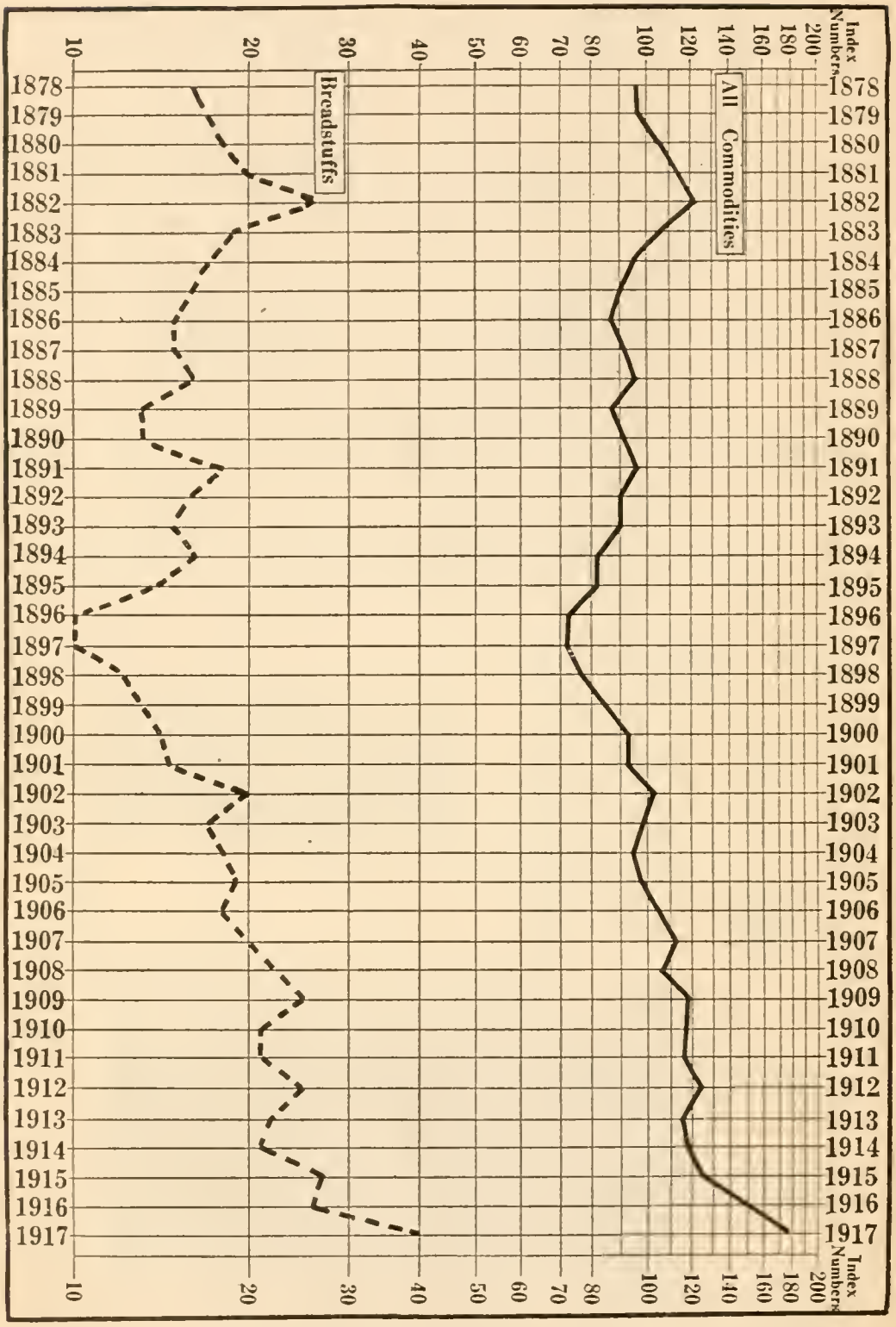

FIG. 9r. THE SAME. RATIO METHOD.
Actually "breadstuffs" fluctuate more than "all commodities."

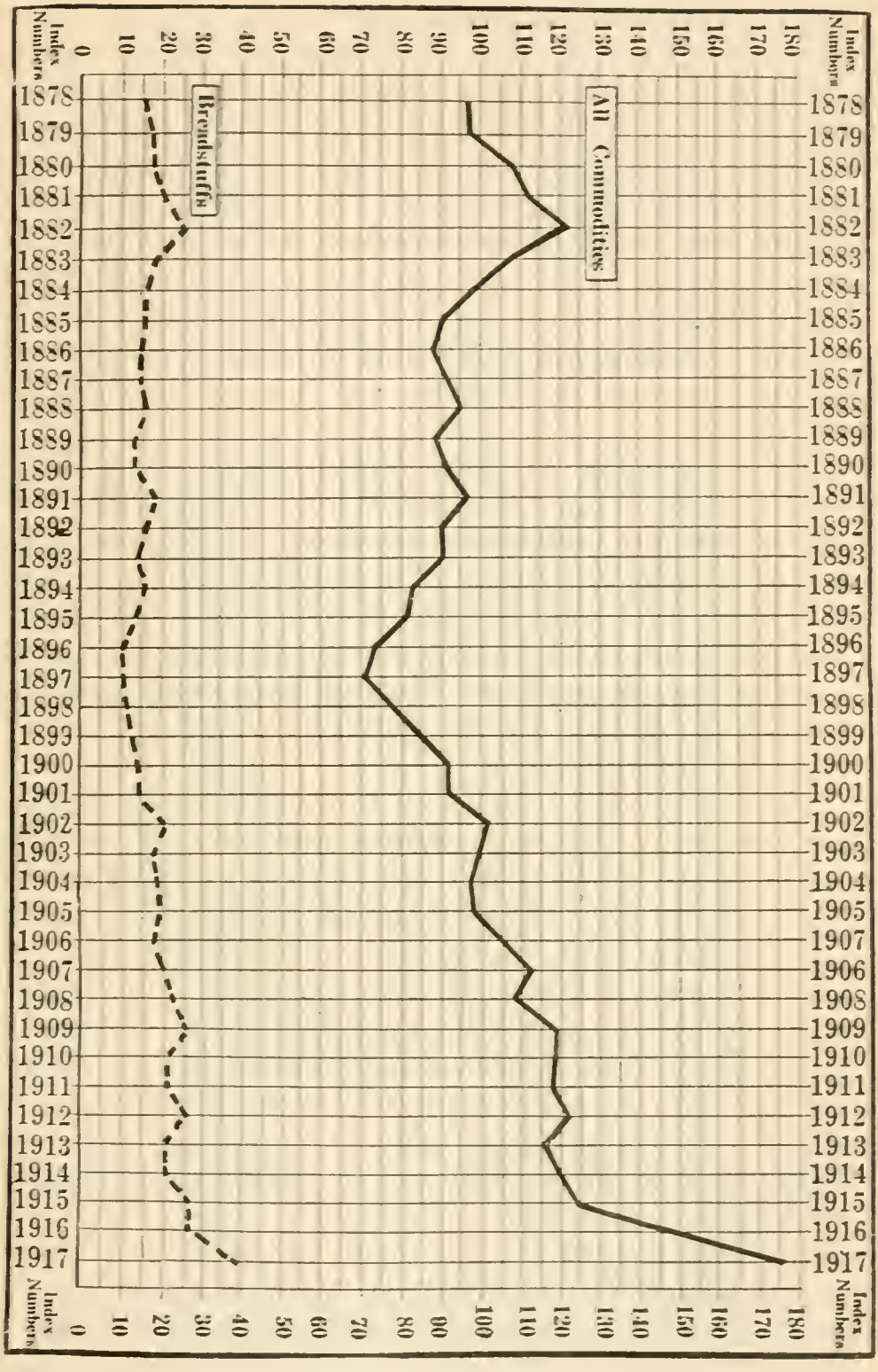

FIG. 9d. INDEX NUMBERS COMPARED. DIFFERENCE METHOD.

Apparently "all commodities" fluctuated more than "breadstuffs."

of the comparative percentage growths except by recourse to tedious arithmetical computations. Thus in Fig. 8 *d* the curves *A* and *B* seem to be exactly similar. But they are far less similar than they appear; for the curve *A* is relative to a remoter base than the curve *B*. If plotted on the same base and scale as *B*, the curve *A* becomes *A'* and its similarity to *B* is greatly diminished. But even this degree of similarity is greater than the statistics warrant, as we see when using the ratio chart (Fig. 8 *r*). This shows the *exact* degree of similarity of the two curves *A* and *B* which turns out to be very small. Thus the ratio chart is an effective means of avoiding juggling with statistics through base-selection or scale-selection.

Fig. 9 *d* and Fig. 9 *r*, taken from a brief article of mine in the New York *Times Annalist* of March 17, 1917, show a type of error opposite to the foregoing, and one taken from actual statistics. Fig. 9 *d* gives the impression that the prices of breadstuffs have fluctuated less than the prices of "all commodities." On the ratio chart, however, as shown in Fig. 9 *r*, although exactly the same numbers are plotted, it is seen that breadstuffs have actually fluctuated a trifle more violently than "all commodities."

For comparing in detail any two curves on ratio charts, such as those in Fig. 9 *r*, we may do what we have just seen is not properly permissible on a difference chart,—we may move bodily either curve, the upper curve downward or the lower curve upward, until the two are close together. Then the various degrees of parallelism or divergence, at various periods of time, may be seen with the utmost clearness. This is done in Fig. 10 *r*.* Such close comparison will usually give quickly, through the eye, a better practical picture, I think, of the degree of correlation and certainly of the location of the correlation, than can be obtained even by laborious calculations of coefficients of correlation.

Index numbers with widely different bases, such as those of Sauerbeck and of the United States Bureau of Labor, if plotted on *difference* charts without especially selecting the scales or without multiplying or dividing by suitable constants, appear

*The scale on the right applies to the lower curve, that on the left to the upper.

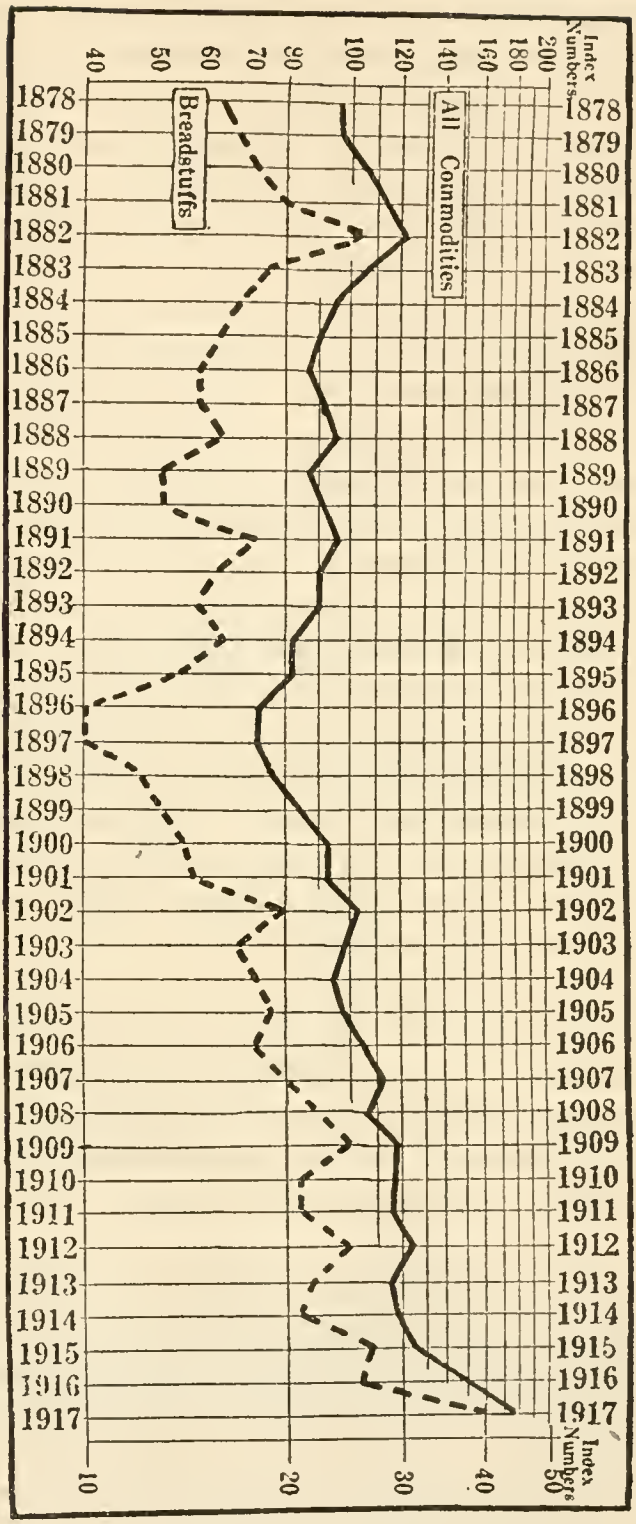

FIG. 10r. THE SAME AS FIG. 9r. RATIO METHOD.

Showing more sharply the contrast by bringing the curves closer together. This procedure is legitimate in the ratio method, but not in the difference method.

far more different from each other than they really are. *Ratio* plotting will show their *exact* similarities and differences.

As was said at the outset, difference charts are useful when difference comparisons are wanted. Not only are such cases rare, however, but often difference comparisons between curves are meaningless, and ratio comparisons are alone possible. This is the case when two curves represent incommensurable magnitudes as, for instance, when a curve of railway gross receipts is compared with one of population or one of the circulation of money with one of the price level. In such cases difference plotting involves a very dangerous discretion in selecting the scale and the base in order neither to exaggerate nor to understate the degree of correspondence. For instance, the close similarity in the recent changes in the money in circulation in the United States, on the one hand, and the price level, on the other, was not evident to me until I plotted the two curves on a ratio chart (Fig. 11 *r*). This similarity might be almost overlooked on a difference chart if the scales for dollars and index numbers were selected arbitrarily.

One special, though slight, advantage of the ratio chart is in representing more clearly than in the difference chart the results of multiplying or dividing a statistical series of numbers by a constant, or by another series, and in exhibiting the resultant third series relatively to the other two.*

ATTEMPTS TO MEND THE FAULTS OF THE DIFFERENCE CHART.

One attempt to secure better comparability of curves in ordinary plotting is that customary in handling index numbers, —namely to reduce all prices to percentages of the base-period price, so that we may start all the curves at an even 100 per

*In detail: (1) to multiply or divide by a constant any series of numbers plotted in a curve is merely to shift the curve bodily up or down by the appropriate constant distance; (2) the reciprocals (of a statistical series plotted in a curve) form a second curve symmetrical (relatively to the unity line) to the first curve; in other words two curves representing reciprocal numbers are such as to coincide if the chart is folded over the unity line; thus a plot representing an index number of prices will be the exact reverse of that representing the purchasing power of money, the one ascending whenever the other descends and at the same angle; (3) the curve formed by plotting the products of two series will be such that its distances from the unity line will be the sum of the differences of the other two from that line; (4) analogously, a quotient of two curves is distant from the unity line the difference of their distances (*i. e.*, distance of the dividend curve less that of the divisor curve). Thus if we plot a curve of acres per *capita* of wheat lands and another of bushels per acre and then plot the curve of their products, *i. e.*, of bushels per capita, the three curves will be seen to be related as just described; the same would apply to index numbers of prices, of wages, and of purchasing power of wages ("real wages").

cent. If the curves do not greatly diverge this gives approximately correct results. But it is a makeshift method and never gives the absolutely exact comparisons of the ratio

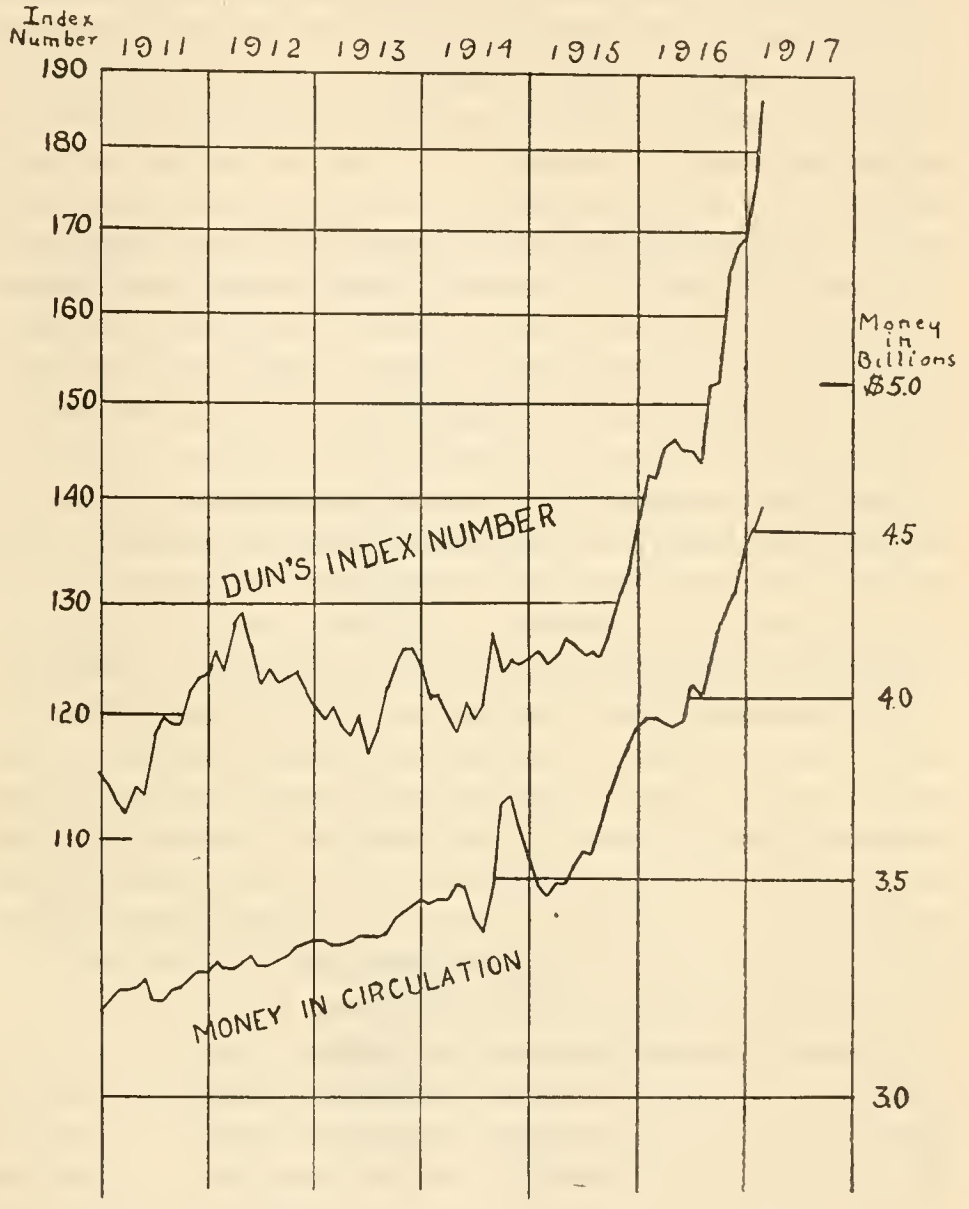

FIG. 11r. MONEY AND THE PRICE LEVEL. RATIO METHOD.

Showing the exact degree in which the price level in the United States has fluctuated in comparison with the amount of money in circulation. Since the war, there has been a close correspondence, changes in the price level following changes in money by two or three months.

method; and, after the curves have diverged considerably, their correct comparison becomes difficult.

Another method is that suggested by Professor Alfred

Marshall. It consists in making a special geometric construction.* But recourse to geometric construction is slow and inexact and does not appeal to the eye.

As a matter of fact, users of charts, when seeking percentage comparisons, are apt simply to read off the four numerical figures opposite the various points (as A and A' and B and B' in Fig. 6 *d* or Fig. 7 *d*) and compute arithmetically the two percentage rates of increase, (*i. e.*, the percentage excess of height of A' over A and that of B' over B). But such a procedure is nothing less than giving up the use of the diagram *as* a diagram and using it merely as a table of arithmetical figures. A diagram is supposed to interpret figures to the eye and to need no interpretation itself through arithmetical processes. When it does need such interpretation, it fails of its purpose as a quick, clear, convenient, and reliable picture.

Finally we note that the foregoing correctives and safeguards necessary for using the "difference" method correctly are, in actual fact, almost invariably neglected. Practically no one uses Marshall's subtangent comparison; few even mentally measure the heights of points above the base line,—much less mentally reckon, from these heights, the percentage rates of change; few even notice whether the base line is inserted or omitted or whether there are different base lines for different curves whose inconsistency needs to be allowed for; growth axes are seldom constructed; few make any effort to shut their eyes to straightness or parallelism in order to avoid being misled into assuming uniformity or similarity of *percentage* changes; few, even, use a diagram as a table of figures.

Professor Marshall says of the ordinary method of curve-plotting: "Its defects are such that many statisticians seldom use it except for the purpose of popular exposition, and for this purpose, I must confess, it has great dangers."† A business

* "On the Graphic Method of Statistics," Jubilee Vol. of the Royal Statistical Society, 1885, pp. 251–60. To help translate the deceptive slope of different lines, such as AA' and BB' in Fig. 6 *d* or Fig. 7 *d*, we produce these lines so that they cut the base line. If, when so produced, they are found to cut the base line at the same point, as is the case in Fig. 6 *d*, where they both cut at Y, then we may know that they have the same percentage slope. If, as in Fig. 7 *d*, they do not cut the base line in the same point, the one which cuts the further off has the smaller percentage rate of increase and the rates of increase per annum of the two lines at A and B are inversely proportional to the distances at which they cut the base as measured from X. Thus if, in Fig. 7 *d*, XY is 14/20 of XZ the percentage change at A is 20/14 of that at B. Again, in Fig. 4 *d* the slopes at A and A' are equal, as $XY = X'Y'$. All of these results may be proved geometrically.

† "On the Graphic Method of Statistics," Journal of the Royal Statistical Society, 1885, p. 251.

man whose attention was recently called to the advantages of the ratio chart recharted his business statistics and was startled to discover how he had been misled by the ordinary method.

After such a severe, but, I believe, just, indictment against ordinary or "difference" plotting it may be asked whether, as usually employed, such plotting is not worse than useless. It is certainly true that ordinarily it misleads to some extent. I have sometimes found myself hesitating to use a curve in a publication, because, on the one hand, of the space it would take up if the base line were inserted and, on the other, of the mistaken impression it might make if the base line were omitted.

The best that can be said for the difference method is: it always shows whether there is an increase or decrease; it usually displays the grosser contrasts at a glance; the base or zero line gives a means, lacking in the ratio method, for plotting zeros, for comparing positive and negative quantities, and for seeing in a simple and self-evident comparison the vertical elevations of points in a curve above the base line.

WAYS OF UTILIZING DIRECTION IN THE RATIO CHART.

The eye reads a ratio chart more rapidly than a difference chart or a table of figures. We may recapitulate what most easily catches the eye as follows:

1. If we see a curve ascending, and nearly straight, we know that the statistical magnitude it represents is increasing at a nearly uniform rate.
2. If the curve is descending, and nearly straight, the statistical magnitude is decreasing at a nearly uniform rate.
3. If the curve bends upward the rate of growth is increasing.
4. If downward, decreasing.
5. If the direction of the curve in one portion is the same as in some other portion it indicates the same percentage rate of change in both.
6. If the curve is steeper in one portion than in another portion it indicates a more rapid rate of change in the former than in the latter.
7. If two curves on the same ratio chart run parallel they represent equal percentage rates of change.
8. If one is steeper than another the first is changing at a faster percentage rate than the second.

9. The imaginary straight line most nearly representing, to the eye, the general trend of the curve, is its "growth axis," and represents the average rate of increase (or decrease); and the deviations of the curve from this growth axis are plainly evident without recharting.

10. The slope of the imaginary line between any two points on a curve indicates the average rate of change between the two.

WAYS OF UTILIZING ELEVATION IN THE RATIO CHART.

The preceding relates to *direction*. As to *elevation*, the eye can, with a little familiarity, translate vertical elevation into numerical ratio; for, as we have seen, a certain elevation represents a 10 per cent. increase, another a 100 per cent. increase, or doubling, etc., etc.*

To one accustomed to using the difference chart the use of elevations on the ratio chart may at first be confusing. But only a few minutes are necessary to learn its use; and this use of the mere elevation for measuring the ratios, or vertical distances, between any two points between the two magnitudes represented by those points, is really easier and more exact than the more self-evident method, in the ordinary chart, of comparing their two vertical distances from the base line.†

*For roughly interpreting elevations without having to read the marginal figures or measure distances, the original system of equidistant horizontals, as shown in Fig. 1 r, is not inconvenient. The chart is divided into horizontal 10 per cent. bands and the eye can approximately reckon how far any point on a statistical curve is vertically above any other point,—whether one band's breadth, or two, or any fractional part, and, therefore, whether it represents a magnitude 10 per cent. more, or 10 per cent. *more than* 10 per cent. more, *i. e.* 21 per cent. more, etc.

†We may also, if we wish, make much more exact comparisons than those afforded by the glance of an eye. We may exactly measure any slope such as that of a tangent to a curve at any point or such as that of a line connecting any two points on the curve. This may be done in accordance with the constructions of the radiating lines in Fig. 3 r; by drawing a line parellel to that of which the slope is desired, from any convenient point in the horizontal line "10". Let this cut the vertical line one unit to the right of said point; the height of this intersection above (or below) line "10" measures exactly the rate of ascent (or descent) of the slope to be measured.

Again we may exactly measure any ratio comparison between two points on the same curve—or on different curves for that matter. All we need to know is the vertical distance between the two points and compare this with the vertical scale above (or below) the line "10," as illustrated in Fig. 3 r. Such a comparison may be made by a draughtsman's dividers, parallel rulers, sliding triangle, or even by using the edge of a sheet of paper and a lead pencil. Thus, if the elevation, as measured, is found equal to the distance between "1" and "2" (or "10" and "20" or "100" and "200") then the upper point represents a statistical magnitude just twice that represented by the lower point; or again, if the measured elevation is equal to the distance between "1" and "1.37" (or "10" and "13.7" or "100" and "137") on the scale, then the upper point represents a statistical magnitude 37 per cent. greater than that represented by the lower point.

SUMMARY.

In the ratio method, then, a straight line* always represents a constant percentage rate of increase or decrease and, conversely, a constant percentage rate of increase or decrease is always represented by a straight line; a curve deviating from a straight line invariably implies that the percentage of change deviates correspondingly from constancy; any two curves or two portions of the same curve which are parallel represent exactly equal percentage rates of change; any two curves or portions of curves which show a contrast of direction always indicate a corresponding contrast in percentage change; if the numbers plotted are halved or changed in any other ratio, the resulting curve will simply be raised or lowered but will maintain exactly the same series of directions and therefore present the same appearance to the eye; if the scale is properly selected, a curve is never nearly horizontal except when it actually represents an almost infinitesimal rate of increase or decrease, nor is it ever nearly vertical except when it actually represents a rate correspondingly enormous; as there is no zero line there is no waste space on its account and the diagrams can be cut off close, both above and below the curve; there can be no juggling with base lines or scales; there is no need of special supplementary geometric constructions, such as Marshall's subtangent construction; there is no need of laborious calculations to reduce original figures to index numbers or percentages; there is no need of eliminating the growth axis (which, in the ratio method, is simply a straight line, the percentage deviations from which are apparent without special calculation or replotting).

The features of a curve which, whether we will or not, most "catch" the eye are concerned with comparative *direction*,—straightness or curvedness; steepness or flatness; parallelism or divergence. These features therefore ought to be, not

*It is interesting to note that engineers have found it advantageous to devise special plotting charts which will reduce parabolic, hyperbolic and probability curves of the ordinary charts to straight lines on the special charts, *e. g.*, see A. S. Langsdorf, "Methods for Determining the Equations of Experimental Curves," Journal of the Association of Engineering Societies, June, 1904, pp. 325-43; L. F. Harza, "Notes on Determination of Experimental Equations," Wisconsin Engineer, December, 1908; George C. Whipple, "Element of Chance in Sanitation," Journal of the Franklin Institute, Vol. 182, July 7, 1916, p. 37; Allen Hazen, "Storage to be Provided in Impounding Reservoirs for Municipal Water Supply," Proceedings of the American Society of Civil Engineers, Nov., 1913.

snares nor stumbling blocks, as they are in the "difference" chart, but aids or sign boards as they are in the "ratio" chart.

And, besides the full utilization of *direction*, we have, in the ratio chart, that of *elevation*. While the interpretation by the eye and mind of elevation requires a little preliminary training it soon becomes easier, more rapid and more accurate than the corresponding procedure for difference charts.

In a word, the ratio chart simply utilizes the natural powers of the eye. Consequently, when one is once accustomed to it, it never misleads, but always pictures a multitude of ratio relations at a glance, with absolute fidelity and without the annoyance of reservations or corrections.

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Professor Jevons seems to have been the first* to employ the idea of the ratio chart. He did not use prepared ruling but employed a table of logarithms and plotted the logarithms of the statistical numbers. While this procedure amounts to the same thing it fails to interpret the method to the average man, for it seems to lose touch with the actual statistical figures.

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*"During the years" (viz., 1863 to 1884) "which have elapsed since this paper and previous essays on the value of gold were printed, I have not happened to learn that logarithmic diagrams had been used before their employment in these inquiries. It must be evident, however, that they furnish the true mode of representing all statistical and other numbers of which the ratios, not the absolute amounts, are in question. Now this is, strictly speaking, the case with almost all numbers used for statistical research, as apart from mere practical accounts." W. S. Jevons, "Investigations in Currency and Finance," London, (Macmillan), 1884, p. 128.

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SALE OF INTOXICATING LIQUORS

STATEMENT

OF

PROF. IRVING FISHER

PROFESSOR OF POLITICAL ECONOMY
YALE UNIVERSITY

BEFORE A

SUBCOMMITTEE ON EXCISE AND LIQUOR LEGISLATION OF THE COMMITTEE ON THE DISTRICT OF COLUMBIA

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STATEMENT OF PROF. IRVING FISHER, PROFESSOR OF POLITICAL ECONOMY, YALE UNIVERSITY.

Senator WORKS. Professor, you have had occasion to study this question of the effect of alcoholic drinks, and the committee is investigating the question of controlling the saloons. We would be very glad to have your views upon that or any other feature of it you desire to take up. You might first tell the committee what your occupation is.

Prof. FISHER. I am professor of political economy at Yale University, and president of the committee of one hundred on national health, which was appointed by the American Association for the Advancement of Science.

I have been interested in the question of alcohol for a number of years. I did not know that I was to appear before this committee when I came to Washington, otherwise I should have come with statistics which I can only give now offhand, without the actual figures.

The CHAIRMAN. I would suggest, Professor, that when you return home, if there is any memoranda you desire to send to the committee, we will be glad to have it put into the record.

Prof. FISHER. I shall be very glad to do that, sir. I have been interested in the problem for a number of years, having some 13 years ago lost my own health and regained it a short time after. I became interested in public health in relation to myself and in relation to my profession of political economy, and for the last 12 years I have been making a study of the relation of health and disease to economics, its relation to the laboring classes, its relation to industry; and when the committee of one hundred on national health was appointed by the American Association for the Advancement of Science five years ago I undertook the preparation of a report, which later was presented to President Roosevelt as a part of the report of the conservation commission of which I was a member. In this report, which endeavored to cover the subject of public health in the United States, I found it necessary to pay considerable attention to the effects of alcohol.

After making what I believe was a thoroughly disinterested study of the question, being perfectly willing to be convinced that alcohol is a benefit or, within limits, is a benefit, or at any rate not an injury, I came personally very strongly to the conclusion, on the basis of statistics as well as on the basis of physiology, that alcohol, so far as we can observe its effects, is an evil and no benefit. As soon as the effects manifest themselves, they are injurious and not beneficial. It is not what we could properly call a stimulant, but it is a depressant. It is apparently a stimulant, because it puts to sleep the nerves that indicate fatigue, so the person says that it relieves fatigue. What it does is to make you unconscious of fatigue.

This summer I visited the great international hygiene exhibition in Dresden, in which was represented the public-health work of all

the nations of the world, with the one exception, I am regretful to say, of the United States of America. That was a world's fair devoted to health, one of the most wonderful exhibits which has ever been seen, the cost being over a million dollars, and being visited by many millions of people.

I was very much surprised to see that in Germany, an alcoholic-using nation, distinctively a beer-dringing nation, that so much attention was given to the evils of alcohol, and I found that at this exhibit there were a number of interesting and new statistics on the subject, and facts brought out by physiologists, and a daily demonstration by a skilled expert on alcohol, which was listened to with very great attention by all of the visitors there, including the Germans.

I also found that the Kaiser was encouraging this antialcohol movement in Germany, that he had spoken against alcohol, had given it up absolutely in his own household, had selected the university to which to send his sons, on the basis largely of the fact that that university had less of the fashion of beer drinking than any other university in Germany.

I found also the statistics of Germany, taken from the recent scientific movement against alcohol—I want to emphasize that word "scientific," because it is not the kind of an alcohol movement that we are accustomed to think of in this country—showed that there has been a striking diminution in the use of alcoholic beverages, including beer, in Germany. Concomitant with this there has been a decline in the death rate.

I was particularly interested to see the statistics for Sweden. I came away from this international exhibition with the feeling that Sweden is the most advanced nation hygienically in the world. Its people have the longest duration of life, the smallest mortality, the smallest infant mortality, the smallest mortality in old age, the smallest mortality all along the line. Not only that, but its improvement in mortality during recent years has been greater than any other nation, although there is less room there for improvement than in any other nation.

They have kept their vital statistics for 150 years—longer than any other nation has kept them. They have kept the record, and they have read the record, and when they had found by these vital statistics, which are really vital bookkeeping, that they were losing in a particular way they tried to remedy that. Swedish massage, Swedish gymnastics, Swedish hard bread, Swedish school hygiene, Swedish inspection of school children, and various other facts, have cooperated in this movement toward better living conditions and better health. But in particular there has been a fight against alcohol there, so that the reduction in the consumption of alcohol has been more striking, I think, than in any other nation. Judging from the impression that I got from looking at the statistics there that is true. At any rate, there has been a very great reduction. I would not dare say offhand what per cent, but looking at the curves there we found that per capita of alcoholic consumption had remained absolutely constant for a number of years, but during the last decade or two had sharply fallen off.

The CHAIRMAN. What has been the result in the vital statistics since that time?

Prof. FISHER. The improvement during the past few decades there has been as great as in almost any other nation. I think not as great as in Prussia, but Prussia had more room for improvement.

The CHAIRMAN. The improvement begins, you might say, with the diminution in the use of alcohol?

Prof. FISHER. The improvement has been going on in the last 150 years, but it has been going on more rapidly of late, and especially of the diseases of late in life.

Senator WORKS. By what means have they reduced the consumption of alcoholic drinks?

Prof. FISHER. They have, by means of what is called the Gutenberg system, by means of which the State takes charge of the liquor traffic, does not sell to minors, and attempts to discourage the practice, and educates the people who come in to buy alcohol as to its effects upon them.

The CHAIRMAN. The State controls it, or rather the sales?

Prof. FISHER. Yes.

The CHAIRMAN. It does not leave it in the hands of private parties?

Prof. FISHER. In Germany the fight against it is conducted on other lines, mostly educational. The reason Sweden has shown a greater improvement in mortality in later ages in life as well as earlier ages in life is that they are fighting alcoholic diseases as well as degenerative diseases. There are two great classes into which we may divide diseases: The acute diseases, which are of the infectious type, such as pneumonia, smallpox, diphtheria, which are more or less self-limiting, which come suddenly and go suddenly; then there are the chronic diseases, which might be called the degenerative diseases, or constitutional diseases, which come in gradually or insidiously, such as rheumatism, gout, Bright's disease, diseases of the heart and nerves.

In most countries the public-health fight has been almost exclusively against the first type, and as a consequence they have improved the death rate of the diseases of earlier in life, where the danger from these diseases is greater, and the consequence is that in England, the United States, and other countries there has been a decline in the death rate up to 50 years. Beyond 50 years it is greater than it used to be in some cases. In the United States it is greater than it used to be beyond 60 years.

In Sweden the opposite is true. It is true all along the line, and the reason for it is that Sweden is fighting the degenerative, the chronic diseases, just as effectively as it is fighting the infectious diseases. The method of fighting the infectious disease is by quarantine, public-health sanitation. The method of fighting the degenerative disease is through personal hygiene, and the question of the individual taking care of himself, the question of fresh air, sleeping out of doors, living out of doors and taking exercise, questions of attire, and questions of mental attitude. These are the methods by which the degenerative diseases are combatted, and I believe that in personal hygiene one of the most important branches is the use one makes of alcoholic beverages.

Sweden has come to this conclusion, and as a consequence they have found a decline in the death rate not only under 50 years of age, but after. Another most remarkable movement in mortality in Europe has been in the city of London. I think it is one of the wonders of the world that the death rate in London has been decreased as it is, and it has been a puzzle to me to find out exactly why. I believe it is due to a combination of causes. As a matter of fact, the death rate in London is as low as the death rate among the whites in the city of Washington, and lower than the average death rate in Washington, although London is the largest city in the world. This has been due largely to the vigorous work in hygiene undertaken by the London county council, including educational means. A short time ago I had a little correspondence with Mr. John Burns in regard to the matter. He is a particularly well-posted man on the subject, because he has taken so much interest in it. You know that he was himself originally a labor man and is now secretary for municipal government and has made a particular study of tuberculosis and of alcohol.

In his reply to my question as to what in his opinion had caused this wonderful decline in the death rate in the city of London, he gave a number of reasons, and among them, and emphasizing it more than any other, was the reason of the decline in the consumption of alcohol, especially among the working classes. He believes, and I believe, and I believe that every unbiased student of the subject believes, that one of the very worst enemies of the working classes is alcohol. It not only is an enemy to health, but it is an enemy to thrift and to economic well being. These two act and react on each other, because if you undermine the health you take away the earning power. Alcohol is one of the chief causes of tuberculosis. That is to say, it is one of the chief predisposing conditions.

Every well-educated expert in tuberculosis, I think, agrees that that is true. A generation ago they would not have believed that whisky was not a good thing for consumption, but now every well-educated expert in tuberculosis believes that alcohol is a predisposing cause. In that way it must have caused a great effect in increasing consumption among the working classes, where consumption is more predominant than in any other class, and therefore responsible for a large amount of the death rate there and the inability to work, because there is nothing that robs a working man of working power so much as tuberculosis. So on either end it injures the health of the workman. By injuring his earnings it injures both his health and his economic well being.

I know that John Burns is right in the belief that the consumption of alcohol has gone down in Great Britain, for only a month ago I believe there was an elaborate article on the consumption of alcohol in Great Britain published in the Journal of the Royal Statistical Society, the great statistical journal of the world, and it shows a decline in the consumption of alcohol in Great Britain, and in the city of London, and it has been very striking, similar to the decline in Sweden, and has been coincident with this great decline in the death rate.

The insurance companies have taken up the fight against alcohol. The insurance companies which are going into public health questions are teaching their risks in regard to alcohol. When the Postal

Life Insurance Co. a generation ago first took up the statistices of this country and tried to compare the mortality between those who were total abstainers and those who were not, they found that those who were total abstainers had the highest mortality. This fact was greeted with glee by the users of alcohol, but it turned out to be due to the fact that the insurance or mutual benefit societies, which consisted of those who did not consume alcohol, were a select class, namely, they were the reformed drunkards, and they were people who were just about to die anyway, and therefore their mortality was very great. It was due to alcohol, not due to lack of alcohol. Within the last generation, when we have had a set of people coming in who were total abstainers early in life, the opposite is true, so that now you find for the Golden Sceptre, and other societies consisting of total abstainers, the death rate among them is less than the average. I recently saw the statistics of the New York Life Insurance Co. in reference to these matters, and they confirm the facts I have recited.

There are a number of other facts that I might give if I had my memoranda here, and if the committee would like to ask questions I shall be very glad to explain in further detail anything I have said, or to answer any objections, so far as I am able without preparation or notes.

Senator Works. Professor, if you have statistics in convenient form on that subject that you would be willing to furnish the committee, and will do it within a few days, we should be very glad to have them.

Prof. Fisher. I think I could send them here within a week.

The Chairman. We will withhold the printing of this record for at least a week. If you will send the statistics we will put them in the record. If there are any suggestions that occur to you afterwards that you think will be of benefit you can add them to your statement.

The following was subsequently submitted in writing by Prof. Fisher:

The Relation of Alcohol to Health.

[By Irving Fisher, president of the Committee of One Hundred on National Health.]

As a statistician and economist, I have made studies during the last 10 years which have led me to the conclusion that while many false and exaggerated statements have been made on the evils of alcohol its general condemnation by scientists of late has not been too strong.

All physiologists agree that, in large quantities at least, alcohol is a poison. Dr. William H. Welch, professor of pathology at Johns Hopkins University, in Baltimore, is quoted [1] as saying that alcohol in sufficient quantities is a poison to all living organisms, both animal and vegetable. The present state of physiological science indicates that if there exists any "physiological minimum" of alcohol which is harmless or beneficial it is exceedingly small. The best statistics indicate that even "moderate" users are injured thereby.

MUSCULAR ENDURANCE.

Dr. L. Schnyder,[2] of Berne, Switzerland, shows, by means of strength-testing machines, that the use of alcohol diminishes muscular power. A striking loss of muscular endurance from the use of alcohol was also shown by diagrams of ergographic experiments exhibited at the Dresden International Hygiene Exhibition in 1911.

Careful experiments with alcohol in relation to fatigue have been reported by Rivers,[3] who shows that alcohol diminishes the capacity for exertion. Experiments

[1] By Henry Smith Williams, M. D., LL. D., in his article on "Physiological Effects of Alcohol," published in McClure's Magazine, and reprinted in The Passing of the Saloon, compiled by George M. Hammell, D. D., Cincinnati (Tower Press).

[2] Alcohol and Muscular Force, by Dr. L. Schnyder, in a compilation on the subject of alcohol by J. Stump (teacher at the Hofwill Seminary), Zollikofen, and Robert Willenegger, Zurich, Switzerland.

[3] W. H. R. Rivers, Influence of Alcohol on Fatigue, etc. London, Edward Arnold, 1908, pp. 89–90.

carried on by Prof. Aschaffenburg with four typesetters, all users of alcohol, showed that on days when Greek wine, containing 18 per cent of alcohol, was given to the men there was considerable diminution of the capacity for work. On the alcohol days two of the men did decidedly less work, while the work of the remaining two was marked by great irregularity.

Not only endurance of exertion, but of exposure to extremes of temperature, is weakened by alcohol. It used to be a common impression that alcohol "warms you up"; consequently explorers and sea captains used it. A more careful investigation has shown that this is not true, and now the opinion is exactly the opposite. Amundsen, in his expedition to the South Pole, used no alcohol except when in winter quarters. Grog "was used as a 'treat' every Saturday night, but when sledging we considered it advisable to carry no spirits."

That alcohol increases fatigue is now commonly recognized by athletes. "Alcohol gives no resistant increase of muscular power. It is well understood by all who control large bodies of men engaged in physical labor that alcohol and effective work are incompatible."[1] It is interesting to know that when the bicycle craze was at its height in this country it reduced the consumption of alcoholic drinks among athletes, for those who were trying to make their century runs demanded temperance drinks.

The following quotation from an article by a competent authority, Dr. Richard C. Cabot, of Boston, is taken from a bulletin[2] issued by the Metropolitan Life Insurance Co. for the education in hygiene of its 8,000,000 policy holders. It is significant as showing the attitude of the great life insurance companies toward alcohol:

"If a man wishes to become an athlete and to go into training the first thing his trainer would tell him would be to cut out alcohol absolutely. In fact, no trainer would undertake to train a man unless he was willing to follow this rule."

THE LABORING MAN.

In the same bulletin Richard Wright, of Cambridge, points out the great importance of abstinence from alcohol to the laboring man. The recognition that alcohol incapacitates for work and increases the danger of accidents (which may be disastrous not only to the employee but to others, as in the case of locomotive engineers) has led to the repression of the use of alcohol. Employers are beginning to understand that, on the subject of alcohol at least, the interests of the employer and the employee are identical. In fact, one of the great causes for the reduction of alcohol in recent years has been the fact that the employer has found it to his financial interest to require total abstinence of his workmen. Dr. Grenfell, the missionary among the Labrador fishermen, says: "Why don't I want to see liquor used at sea? Because, when I go down for a watch below, I want to feel that the man at the wheel sees only one light when there is only one light to see."

It has been reported that the New York Central Railroad, the Lackawanna, the Pennsylvania, the Baltimore & Ohio, the Wabash, the Rock Island, and the Great Northern have prohibited the use of intoxicants by employees while on duty; also that the United States Department of Commerce and Labor sent circulars to the larger employers throughout the country to obtain information concerning their attitude in regard to the use of liquor by employees and received replies from 1,794 establishments, which showed that the use of intoxicating liquors was forbidden either in whole or in part.

I understand also that the United Mine Workers of America have recently shut out saloon keepers and bartenders from membership in that organization. It is not surprising to find that labor leaders are beginning to appreciate the importance of the subject. This is true particularly in England. One of the best and latest statistical documents in regard to the recent decline in the consumption of alcohol and its causes is that by George B. Wilson on Variations in the Consumption of Intoxicating Liquors,[3] in which he says:

"The rise of the great teetotal friendly societies, the Independent Order of Rechabites and the Sons of Temperance, is but an indication of a marked change in the attitude of the working classes to this question. * * * The attitude also of the leaders of the Labor Party, who are not merely, in the great majority of cases, personal abstainers, but also strong advocates among the workers of total abstinence, has been an important factor. * * * The growth of this great army of total abstainers among the working classes from 177,000 in 1890 to 640,000 in 1910 is a significant

[1] The Liquor Problem: A Summary, report of the subcommittee of Committee of Fifty on Physiological Aspects of the Liquor Problem. New York (Houghton-Mifflin), 1905.
[2] Vol. 25, No. 11.
[3] Journal of the Royal Statistical Society, Vol. LXXV, Part II, January, 1912.

indication of the change that is in progress, and it is beyond doubt that the workingman who 'drinks' loses caste among his fellows to a far greater extent than he would have done 20 years ago."

MENTAL FITNESS.

Alcohol decreases the capacity not only for physical but also for mental work. Dr. Cabot states:[1]

"While alcohol affects the body, the greatest harm done by it is to the mind and brain. The constant use of alcohol is bad for the stomach and liver. But these effects, while distinctly harmful, are relatively unimportant as compared with the influence of alcohol on the mind and brain."

Dr. A. Smith shows, by elaborate tables, that alcohol tends to diminish the ability to memorize figures.[2] These and other data[3] show that the number of mental errors, such as in adding figures, etc., made by users of alcohol is very much greater than the number made by abstainers. A subcommittee of the committee of 50, appointed to investigate the liquor problem, states:[4]

"Experiments made on the effect of the continued daily administration of 40 to 80 grams of alcohol show a decrease after a few days in the ability to memorize and to add figures. This depression disappears rapidly on leaving off the alcohol."

The effects of beer and wine on mental faculties was tested by Bayer in Vienna, who made observations on 591 public-school children, who were ranked by their teachers in three groups—"good," "fair," and "poor." The results of these observations are given in the following tables:[5]

Total, 591 pupils.	134 were total abstainers.	164 drank alcohol seldom.	219 drank beer and wine once daily.	71 drank it twice daily.	3 drank it thrice daily.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Good	42	34	28	25	.....
Fair	49	57	58	58	33
Poor	9	9	14	18	67

E. Kraepelin, professor at the Universität Heidelberg, also tells us that alcohol diminishes rapidity in adding figures.

INSANITY.

It is well known that alcohol is a potent cause of insanity. Kraepelin further tells us[6] that 10 to 30 per cent of all mental illness is due—in part at least—to alcohol, and that the male sex shows at least 10 times as great a frequency of alcoholic insanity as the female. We are told by Dr. Frederick Peterson, president of the New York State Commission in Lunacy, that "In the State of New York there are now some 30,000 insane persons in public and private hospitals. It is believed that about one-fifth of them, or 6,000 patients, owe their insanity to alcohol used either by themselves or by their parents. In the asylums of the United States there are 150,000 insane people, and, if we take the same proportions as before, there are 30,000 persons in this country whom alcohol has made or has helped to make insane. * * * Dr. Macdonald, who is one of the greatest specialists on insanity we have in this country, thinks that one insane person causes a loss to the State of nearly $400 a year. The total loss in money to the State of New York caused through alcoholic insanity must therefore be $2,400,000 and the United States $12,000,000 every year."[7]

CRIME.

Crime is usually, if not always, a manifestation of mental aberration—temporary or chronic—and this mental aberration is in a great number of cases due to alcohol. The Massachusetts Bureau of Labor investigations showed that "84.41 per cent of all the

[1] Journal of the Royal Statistical Society, Part II, January, 1912.
[2] Table B1, in compilation by J. Stump, loc. cit.
[3] By J. Joss, in compilation by J. Stump, loc. cit.
[4] Physiological Aspects of the Liquor Problem, Vol. II, edited by John S. Billings, Boston (Houghton-Mifflin), 1903.
[5] Taken from Physiological Effects of Alcohol, loc. cit.
[6] Psychiatrie, Leipzig (Barth), 1899.
[7] In the Metropolitan, loc. cit.

26,672 crimes [for which there were convictions in Massachusetts in 1895] were due to intemperate habits, and 82 per cent were committed while the criminal was under the influence of liquor." [1] The late Edward Everett Hale, a lifelong observer of social conditions, is reported as saying:

"If anybody will take charge of all Boston's poverty and crime which results from drunkenness, the South Congregational Church, of which I have the honor to be the minister, will alone take charge of all the rest of the poverty which needs relief in the city of Boston."[1]

Richard Wright states:

"Dr. Stehr's chart confirms scientifically what has long been generally known, that accidents and crimes of violence increase rapidly with the drinking of alcohol. This is why Sweden stopped the sale of alcohol during the recent strike in that country, and San Francisco and Chelsea shut up their saloons during the earthquake and fire."[2]

The general conclusions of the committee of 50 after its investigation which covered a period of three years, carried on under the general direction of Prof. Henry W. Farnam, of Yale University, were that liquor was a first cause in 31 per cent of the criminals studied, and that it entered in as a cause, directly or indirectly, in 50 per cent. Mr. Samuel J. Barrows states[3] that "of 30,000 prisoners examined, * * * 41 per cent committed their crime under the influence of alcohol. In Belgium Prof. Thiry makes the general proportion 45 per cent."

Although police convictions are not a perfect indication of the use of alcohol, but often merely an indication of the vigilance and spirit of the police, they are nevertheless of some value, especially in England, where the administration of the law is less variable than in this country. George W. Wilson states[4] that "there is a real connection between the variations in the consumption of intoxicating beverages in the United Kingdom and the variations in the number of proceedings and convictions for offenses connected with intoxication."

Temperance reform almost invariably leads to a reduction in crime. The prison commissioners for Scotland are quoted by Wilson [5] as showing that "There can be no doubt that there is less intemperance in the country; the change perhaps not very perceptible among the class who are habitually or very frequently intoxicated, but it is noticeable in the great reduction of crime and offenses by persons who occasionally become intoxicated and then commit crimes and offenses of all kinds."

SOCIAL EVIL.

Alcohol leads not only to crime, but to vice. This effect also may be regarded as due to alcohol by producing an abnormal state of mind. The dean of the Yale Medical School, at a meeting in New Haven, Conn., March 11, 1911, stated that young men usually go astray morally under the influence of alcohol. Forel [6] says that one can scarcely expect to make successful headway against the social evil unless at the same time an uncompromising fight is waged against alcohol. An official in the office of the district attorney in New York reports that the houses of prostitution would, in many cases, probably not be able to exist were it not for the sale of alcohol in them. And it is even more certain that their patronage would be greatly reduced were it not for the custom of using alcohol as a beverage in the community generally.

Anything which diminishes the consumption of alcohol has been shown to diminish the social evil. In this, as in other ways, hygiene and morals are intimately related—the relation being primarily a physiological one; for alcohol not only produces abnormal desire, but reduces the strength of will by which such desire is resisted.[7]

DEGENERATION.

The influence of alcohol on physical degeneration was recognized by the British parliamentary committee on race degeneration in that country. The report of that committee [8] showed that they considered alcoholic stimulants harmful to the race. Dr. T. D. Crothers, of Hartford, Conn., states that "There are to-day over a million unrecognized inebriates who are the most defective, dangerous, and degenerate of

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[1] What People Have Said About Whisky, loc. cit.
[2] From The Metropolitan, loc cit.
[3] "The temperance tidal wave," in the Outlook, vol. 89, No. 10, July 4, 1908, p. 515.
[4] Loc. cit.
[5] Loc. cit., p. 239.
[6] The Sexual Question, by August Forel, M. D., Ph. D., LL. D., formerly Professor of Psychiatry at and Director of the Insane Asylum in Zurich, Switzerland. New York (Rebnab Co).
[7] The harmful effect of alcohol on sexual life is described by Dr. Gerhard Hahn in chapter 9 of Das Geschlechtsleben des Menschen. Leipzig (Barth), 1911.
[8] Report of the Inter-Departmental Committee on Physical Deterioration, Vol. I, London (Wayman & Sons), 1904.

all classes."[1] A series of statistics collected by J. Stump[2] show a close relation between alcohol and degeneration, insanity, criminality, idiocy, physical defects, etc. Statistics given at the Dresden International Hygiene Exhibition showed that users of alcohol have three and one-fourth times as many bad teeth as abstainers. Dr. Frederick Peterson reports[3] that out of 2,500 idiots, epileptics, and imbeciles admitted to a certain hospital, over 41 per cent had drunken parents, and Dr. Crothers gives figures[4] to show that over 50 per cent of all inebriates and alcoholics come from inherited degenerations, and are literally the expression of transmitted defects. It is fair to say, however, that while degeneration may lead to alcoholism, there is no convincing evidence that alcoholism leads to inherited degeneration. In fact, some scientific investigations of the Galton Laboratory for Eugenics, at University College, London, tend to show that no such inheritance exists

ILLNESS.

But however true or untrue it may be that inabilities due to alcohol are transmitted from parents to child, certain it is that alcohol actually produces such inabilities in the individual. As Metchnikoff points out, alcohol predisposes to disease; "it lowers the resistance of the white corpuscles, which are the natural defenders of the body. It is well known that people who indulge too freely in alcohol show far less resistance to infectious diseases than abstemious individuals."[5] The late Sir Andrew Clark, the great London physician, said:

"I am speaking solemnly and carefully in the presence of truth, and I tell you that I am considerably within the mark when I say to you that, going the round of my hospital wards to-day, seven out of every ten owed their ill health to alcohol."[6]

"Statistics of English sick benefit societies—the Sons of Temperance, Odd Fellows, and Foresters—show a remarkable superiority of abstainers over users of alcohol," according to J. Stump;[2] "in respect to frequency of illness, the illness of the abstainers is about half that of the users of alcohol, and for those between 55 and 65 years of age less than one-fifth." A basis for computing the sickness that might be saved by total abstinence and nonabstaining societies was made by Mr. H. Dillon Gouge, public actuary of South Australia, in 1892. He found that the average weeks of sickness in three societies of abstainers was 1,248; in three societies of nonabstainers the average weeks of sickness was 2,317 (lacking only one-sixth of being twice as much). Metchnikoff states:

"According to the careful investigations of a Swedish doctor, Edgren, published in his 'Monograph on Arterial Sclerosis,' one case in every five of this disease is caused by syphilis, and he shows that chronic alcoholism is an even more frequent cause (25 per cent). These two factors, when united, are responsible for nearly half (45 per cent) the cases of arterial sclerosis that occur."[7]

TUBERCULOSIS.

That alcohol is predisposing to tuberculosis is stated by Drs. Knopf, Flick, Huber, and other authorities. It was also shown by the exhibit of the German central committee for the prevention of tuberculosis.[8] Dr. Crothers states:[9] "Statistics of consumptives show that a very large proportion of these were spirit and beer drinkers in the early stages, with marked symptoms of dyspepsia, faulty nutrition, and exhaustion." The International Congress on Tuberculosis, at Paris, in 1905, passed a resolution "That, in view of the close connection between alcoholism and tuberculosis, this Congress strongly emphasizes the importance of combining the fight against tuberculosis with the struggle against alcoholism."

MORTALITY.

Alcohol is not only responsible for a vast amount of physical and mental and moral infirmities and abnormalities, inefficiency, invalidity, illness, insanity, degeneration, with resulting misery, vice, and crime, but in many cases it directly causes death and in others indirectly contributes to the cause of death. This has been true to the extent of exterminating certain races. We have a well-known example in the case of

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[1] "The Sanitary Side of the Drink Problem."
[2] Loc. cit.
[3] "Alcohol and the child's heritage," The Metropolitan, loc. cit.
[4] "Some Distinct Psychoneuroses common to all cases of Inebriety and Alcoholism."
[5] The New Hygiene, by Elie Metchnikoff, Chicago (Keener), 1906.
[6] What People Have Said About Whisky, loc. cit.
[7] The Nature of Man, by Elie Metchnikoff, New York (G. P. Putnam's Sons), 1903.
[8] In their catalogue entitled "Guide du Musée Ambulant de la Tuberculose," published by Dr. Klebmet.
[9] "Tuberculosis Due to Toxæmic State."

the American Indians. The same influence which they felt in extreme, the white men, with a more moderate use of alcohol, still suffers, but in a more moderate degree. Sir Victor Horsley and Mary D. Sturge, M. D.,[1] show that liquor sellers have a mortality 62 per cent higher than the average mortality of adult males, while abstainers are 44 per cent lower than the average.[2] J. Stump's figures [3] show that the abstainers have a mortality only three-fourths as great as that of the nonabstainers. His statistics of the United Kingdom Temperance and General Provident Institution, applying to over 31,000 users of alcohol and over 29,000 abstainers, and covering a period of 60 years from 1841 to 1901, show that the mortality from alcohol users is greater than that of abstainers at practically every age of life, the excess being least after 70 years of age, and greatest between the ages of 35 and 40, at which time the mortality from alcohol users is almost double (82 per cent greater than) the mortality of abstainers.

Since the figures of the Mutual Life Insurance Co. of New York [4] give the same advantage to American abstainers (23 per cent lower death rate), it seems fair to take the available computations of the English life insurance companies as a basis for estimating the saving of life that would result in the United States if we should all decide to give up the use of alcohol. Of course, however, it should be remembered that the favorable figure of total abstainers is partly due to the fact that as a class they practice personal hygiene in all its forms.

The committee of the Harveian Society of London, appointed in 1879, says: [5]

"We find, therefore, upon the whole, reason to think that in the metropolis the mortality among any considerable group of intemperate persons will differ from that generally prevailing among adults in the following important particulars, viz: A fourfold increase in the deaths from diseases of the liver and chylopoietic viscera; a twofold increase in the deaths from disease of the kidney, a decrease half as much again in those from health disease, a marked increase in those from pneumonia and pleurisy, a considerable increase and an earlier occurrence of those from disease of the central nervous system; a marked decrease of those from bronchitis, asthma, emphysema, and congestion of lungs, a decrease nearly as great in those from phthisis, and a later occurrence, or at least termination, of the disease; a very large decrease in those from old age, with an increase of those referred to atrophy, debility, etc., and the addition of a considerable group referred in general terms to alcoholism, or chronic alcoholism, or resulting from accidents."

Newsholme states: [6]

"So far it can be stated with a high degree of probability that over 6,000 deaths of men are annually caused in England and Wales by diseases induced by alcoholic indulgence. For every 100 such deaths among men there are, according to the English experience, 81 among women. It is evident, therefore, that nearly 11,000 deaths were probably caused in England and Wales in 1904 by the two conditions [3] which can with certainty be ascribed to alcohol. This means that about 5 per cent of the total deaths in adults are caused by alcohol. This percentage probably very greatly understates the real facts."

The best authority on the subject of the mortality of alcohol users in this country is undoubtedly Mr. Edward Bunnell Phelps. In his book [3] on this subject he shows that the male deaths in the area of the United States for which we have accurate registration of deaths, between the ages of 20 and 74, inclusive, 12 per cent of the cases of tuberculosis of the lungs are due in whole or in part to alcohol; 16 per cent of the deaths from heart disease; 22 per cent of the deaths from pneumonia; 22 per cent of the deaths from paralysis; 22 per cent of the deaths from apoplexy; 23 per cent of the deaths from suicide; 23 per cent of the deaths from diseases of the arteries; 30 per cent of the deaths from Bright's disease; 67 per cent of the deaths from cirrhosis of the liver; and 100 per cent of the deaths from alcoholism. There are also deaths from accidents and other causes partly due to alcohol. Mr. Phelps also states [3] that the net results of an effort to arrive, by means of a statistical investigation, at a tentative approximation of the mortality of alcohol in the United States "indicate that, roughly speaking, alcohol may have been directly or indirectly responsible for about 66,000

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[1] In Alcohol and the Human Body, London (Macmillan), 1908, p. 350.

[2] These comparisons are based on the registrar general's return and the experience of the Independent Order of Rechabites for the years 1878-1887.

[3] Loc. cit.

[4] "Effect of total abstinence on the death rate," by Joel G. Van Cise, actuary of the Equitable Life Assurance Co. of the United States.

[5] British Medical Journal, Jan. 20, 1883, p. 97, quoted by Edward Bunnell Phelps in The Mortality of Alcohol, New York (Thrift Publishing Co.), 1911.

[6] Taken from The Mortality of Alcohol, loc. cit. (p. 20), where it was introduced as follows:

"Dr. Arthur Newsholme, one of the foremost statistical authorities in Great Britain, and a cautious and conservative student of mortality due to alcoholism, states in a composite work of 14 medical authorities on 'The Drink Problem in its Medico-Sociological Aspects,' edited by T. N. Kelynack, M. D., 1907."

deaths in continental United States in 1908, or for about 1 in every 13 deaths at adult ages, a figure equivalent to 5.1 per cent of the total mortality from all causes at all ages." He shows, further, that 5.1 per cent of the total mortality at all ages would be about 7.7 per cent of the total mortality at adult ages. He says:

"It should be clearly understood that this figure by no means signifies that alcohol was the direct cause of 66,000 deaths, the number in question presumably including all of the deaths in which alcohol played any appreciable contributory part." [1]

From what has been said, we should expect a decline in the death rate to follow a reduction in the use of alcohol. This turns out to be the case. The following diagram shows the decline in the consumption of liquor in the United Kingdom from 1890 to 1909, the consumption of 1890 being taken as 100 for purposes of comparison.[2]

John Burns, the English labor leader and statesman, a very capable observer, intimately acquainted with the working classes and with statistics concerning them, has stated repeatedly that in his opinion there is no doubt that the decline in the death rate is partly due to the decline in the use of alcoholic beverages. The following table shows the remarkable decline in the death rate per 1,000 of population in London: [3]

1890	21.1	1897	17.8	1904	16.5
1891	21.1	1898	18.4	1905	15.6
1892	20.3	1899	19.5	1906	15.8
1893	20.9	1900	18.6	1907	15.3
1894	17.4	1901	17.2	1908	14.6
1895	19.5	1902	17.4	1909	15.0
1896	18.2	1903	15.4	1910	13.7

There has been a fall in the death rate almost every year, and many other causes besides temperance must have contributed to this result. It is interesting to observe, however, that, beginning with 1900, when the great reduction in the consumption of alcohol began, the fall in the death rate has been more than twice as rapid as previously.

The history of alcohol in Sweden is especially interesting, for the reason that at one time Sweden was very excessive in the use of alcohol. This was especially true after 1775, when Gustavus III introduced a State monopoly of manufacturing spirits for the purpose of securing revenue. This system operated in Sweden at that time in the same way that a corresponding system now operates in Russia. In Sweden then, as in Russia now, the people were actually urged to increase their consumption of spirits. At that time the death rate in Sweden was high, and it remained high as long as this system of putting a premium on the use of alcohol was in vogue. The consumption of alcohol increased and seems to have reached a climax in about the year 1830, when the term "drunken Sweden" had become a byword. It was estimated that the consumption of alcohol amounted to 20 liters of pure alcohol per capita per year—nearly five times the present consumption.

Under the leadership of Peter Weiselgren, dean of Gothenburg, a strong wave of temperance reform set in, which led first to the formation of a public sentiment against alcohol and a reduction in its use, and later to the reform legislation of 1855, which resulted in a still further reduction. These reforms led to the well-known Gothenburg system, which was finally perfected a decade later. Under this system the

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[1] Mr. Phelps names two factors which explain why the percentage of deaths from alcohol is probably greater in England, as shown by the Harveian Society's investigation, than in the United States, as shown by his own. These two factors are: First, the larger percentage of rural population in the United States as compared with the merely urban population considered by the Harveian Society's investigation; second, the much higher ratio of female deaths attributed to alcohol by the Harveian Society's investigation, namely, 5 per cent, as compared with 17 per cent. Mr. Phelps goes on to state:

"Leaving out all other clearly defined differences between the conditions of London in or about 1880 and the United States in 1908, the two factors named fully account for most, if not all, of the difference between the Harveian Society's assumed raito of 14 per cent and this investigation's conclusion of 7.7 per cent as indicative of the proportion of all deaths at adult ages directly or indirectly due to alcohol in London in 1880 and in continental United States in 1908.

* * * * * *

"In conclusion, it would seem that in all probability the approximate total of 66,000 deaths assumed to be the mortality directly or indirectly due to alcohol in this country in the year 1908 is not only an outside figure, but possibly one somewhat in excess of the real number of deaths which would properly be so chargeable if there were any means of measuring the actual experience of the Nation. Apparently not more than 1 in 13 deaths at adult ages is even remotely attributable to alcohol, instead of the 1 in 6 deaths at all ages which Mr. Reid and some other writers on the subject would have us believe are so chargeable. The conclusions of this paper have been reached by clearly defined statistical processes, every detail of which may be critically examined and accepted or rejected, whereas practically all of the preceding figures of the last 25 years have been mere generalizations. Which conclusions are fairly entitled to the greater degree of credence?"

[2] From article by George B. Wilson in the Journal of the Royal Statistical Society, loc. cit.

[3] From the Registrar General's Annual Summary of Marriages, Births, and Deaths in England and Wales and in London, 1910 (revised).

monopoly of selling liquor is given by special license from the Government to a particular company in each locality. Those who obtain this license are limited in their profits from alcohol to the ordinary interest on their capital, the surplus reverting to the State for public purposes. As these licensed companies also sell food, they have an incentive to increase their sales of food rather than of alcohol, as the sales of alcohol are subject to special restrictions and systematically discouraged, just as a century earlier they had been systematically encouraged.

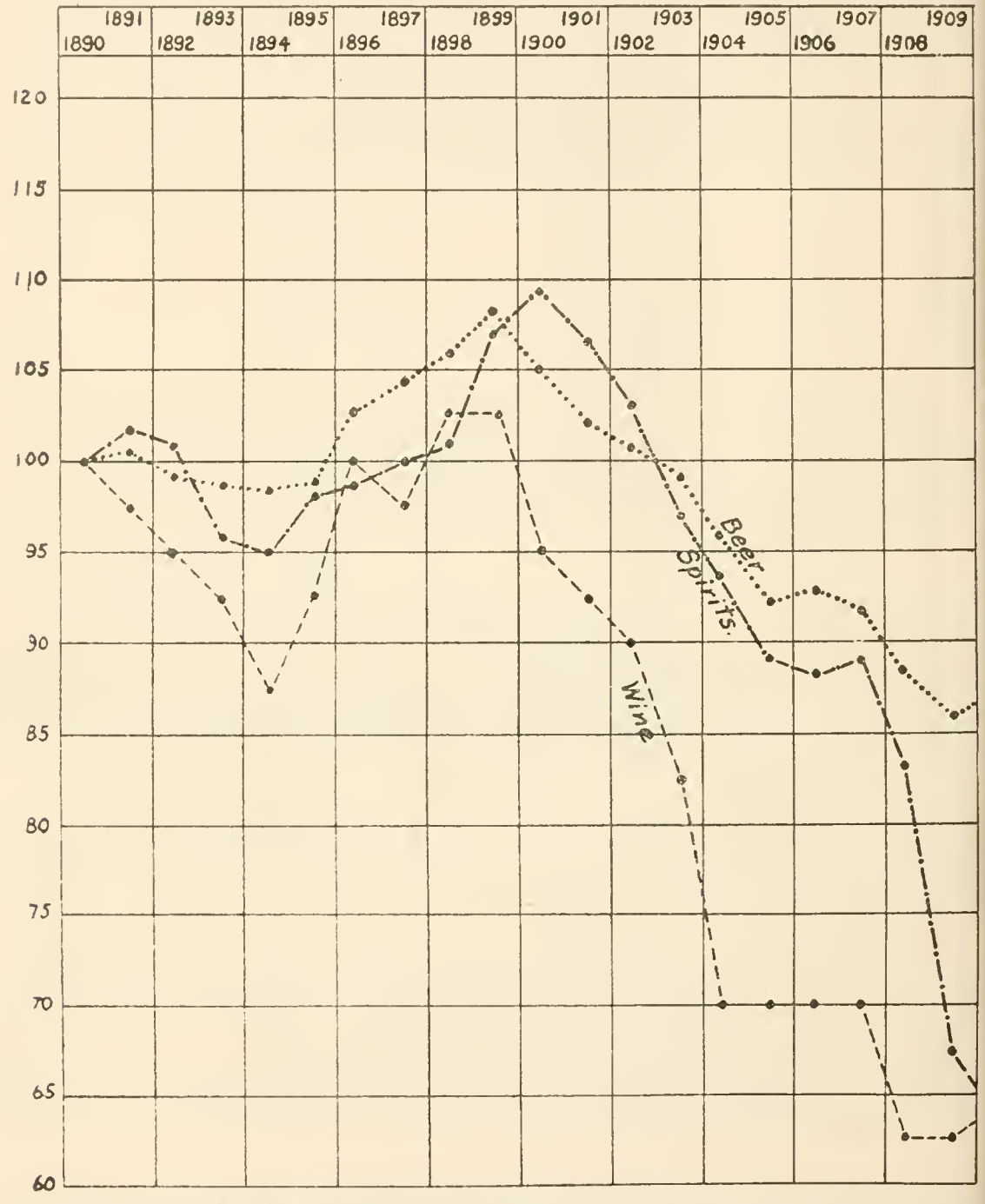

FIG. 1.—The per capita consumption of beer, spirits, and wine in the United Kingdom during the years 1890 to 1909, reduced to the standard of 1890.

The first effect of Swedish temperance reform was to decrease the consumption of spirits and increase that of beer, but latterly the consumption of beer has also decreased, as well as of spirits and wines, until now Sweden is one of the smallest users of alcohol of the nations of the world, and temperance sentiment is exceedingly strong among the people, especially the working classes.

The Rev. Clarence True Wilson, D. D., stated about a year ago:[1]

"Particulars regarding the remarkable plebiscite on prohibition recently taken in Sweden illustrate the thorough nature of the agitation in that Scandinavian country. The State was sown almost knee deep with prohibition tracts; an army of volunteer workers were enrolled; and the question was stirred in every church and chapel throughout the land. The overwhelming victory for prohibition confirms the judgment of a well-known writer that 'Sweden has been changed in a few generations from one of the drunkenest countries of the world to the soberest' * * * In all the country parts of Sweden, with 4,000,000 of population, there are at present only about 140 spirit shops."

The following table shows the estimated consumption, in terms of pure alcohol, per capita, per annum:[2]

	Liters.		Liters.
1861–1870	5.3	1896–1900	5.1
1871–1880	6.1	1901–1905	4.9
1881–1890	4.5	1906–1910	4.4
1891–1895	4.2		

It is interesting to observe that the death rate in Sweden, while its decline has been under the combined influence of many other mighty factors at work in that country, as to a certain extent in all countries, has exhibited at least an apparent relation to the consumption of alcohol. During the period when Sweden was becoming increasingly alcoholic the death rate showed substantially no decline. Since the temperance reform was undertaken in earnest, in the middle of the nineteenth century, the decline of the death rate has proceeded with great rapidity, until now it is about half of what it was 150 years ago. It is significant that the decline in the mortality in Sweden is a decline at all ages—the mortality of octogenarians, for instance, being less than it used to be. This is not true of most other countries, where the fight to lower the mortality has been mostly against infectious or epidemic diseases, instead of against diseases combatted by personal hygiene.

The figures for the Swedish death rate per thousand of population are as follows

1751–1760	27.4	1904	15.3
1801–1810	27.9	1905	15.6
1851–1860	21.7	1906	14.4
1891–1900	16.4	1907	14.6
1901	16.1	1908	14.9
1902	15.4	1909	13.7
1903	15.1	1910	14.0

The death rate in Sweden is now the lowest of any country in the world.

"In Sweden the House of Representatives, by a vote of 89 to 86, declared in 1907 approval of the principle of prohibition, which was put into effect temporarily throughout the national strike from the 4th to the 31st of August, 1909, with an immensely beneficial result. Restaurants only were permitted to serve wine and beer with meals. The mortality in Stockholm for the 8th to the 14th of August, 1909, was but 8.7 pro mille, as against 13.4 pro mille as the average for the corresponding days in the previous 10 years.

"Official police court statistics during the strike show that at Gothenburg, in August, 1908, there were 847 arrests for drunkenness; during August, 1909, but 113; from September 1 to September 7, 1908, 188 arrests; September 1 to 7, 1909, only 3; on September 8 the public houses were opened again, and from September 8 to September 19 there were 259 arrests. At Stockholm, in August, 1908, there were 1,549 arrests for drunkenness, but 169 only in August, 1909; at Nykoping, 26 arrests for August, 1908; 1 only in August, 1909. Orebro showed 100 police court cases, 84 of which were for drunkenness, in August, 1908; 9 only, and none for drunkenness, in August, 1909. At Malmo, in August, 1907, 346 arrests for drunkenness; August, 1908, 443; August, 1909, 175, of whom 152 were in the streets adjoining the port. Most of the men arrested were foreigners who came directly from Copenhagen. These improvements were all assigned to prohibition, which was hailed with satisfaction by the great mass of the workingmen. On August 11, at Stockholm, a meeting of 20,000 strikers begged the Government to lengthen the period of prohibition.

"By request of Parliament, the Government has appointed a committee to investigate and make clear how the provincial boards and assemblies (county councils), the communities, and the State may be released from economical dependence upon the drink traffic."[3]

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[1] "Seeing the World," by Prohibition Biplane, the American Prohibition Yearbook for 1911. Chicago (National Prohibition Press).

[2] Statistisk Tidskrift, 1912, p. 123.

[3] Rev. Clarence True Wilson, D. D., loc. cit.

In Germany the temperance movement is making remarkable headway considering the fact that for centuries beer drinking has been almost universal. The reform is being led by the Kaiser, and the history of all reforms shows that they progress more rapidly when led by the "top" of society rather than from the "bottom." It was especially noteworthy that at the great International Hygiene Exhibition at Dresden in 1911, organized by German genius, a "demonstration" of the alcohol exhibit was made twice a day. In a spirit of liberality, brewers were allowed to make a special exhibit, but the management of the exhibit, in their official daily "demonstrations," set forth the most recent scientific conclusions, which are, as has been shown above, against the use of alcohol as a beverage.

The decline in the consumption of beer in Germany since ~~1890~~ 1900 is shown by the following diagram:[1]

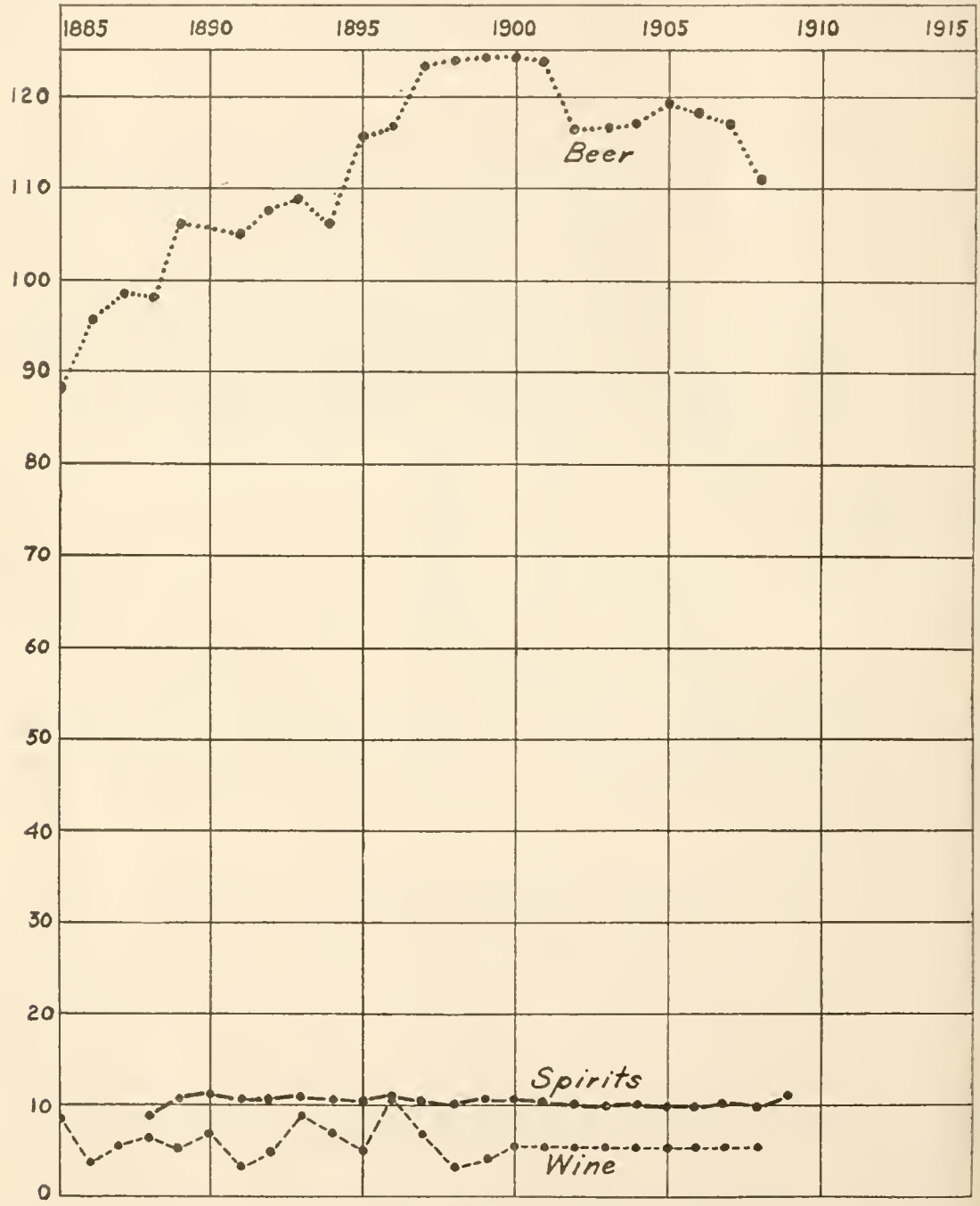

FIG. 2.—The use of alcoholic beverages in Germany in liters per capita.[1]

The Kaiser is reported as having said: "The nation which takes the smallest quantity of alcohol will win the battles of the future."

[1] From the "Reichsarbeitsblatt," March, 1910, reproduced from the catalogue of the exhibition on alcoholism, at the International Hygiene Exhibition, Dresden, 1911. Berlin (Mässigkeits-Verlag), 1911.

"Moltke, himself an abstainer, said: 'Beer is a far more dangerous enemy to Germany than all the armies of France.'" [1]

Germany, like Sweden, shows a very rapid decline in the death rate.

In the United States the per capita consumption of spirits, wines, and beer has as yet shown little sign of decreasing. That of spirits is less than it was in 1840 to 1870, but is about the same as in 1870. The consumption of wines has increased, with some fluctuations, from 1840 to the present time, while the consumption of beer increased rapidly from 1840 to 1890, since which time it has increased less rapidly. During the last five years the consumption of all three has remained substantially constant.[2] It is not unlikely, therefore, that we are passing over the crest of a wave, and shall in the next decade see a substantial decline such as has taken place in several of the countries of Europe. We are a backward country, and far behind Sweden, Germany, and England in the appreciation of hygiene in all its branches. Nevertheless, we are beginning to be aroused to the situation, and the death rate in the United States (registration area) has declined slightly during the last decade.

LONGEVITY.

To lower the death rate means to increase the length of human life. Two generations ago it was supposed that alcohol was conducive to longevity. About that time an English Quaker, applying for life insurance, was charged a higher premium because he was a total abstainer. The basis for this opinion seems to have been that the first societies of total abstainers showed a higher mortality. But this was because they consisted of reformed drunkards; their death rate was high—not because they were abstainers, but because they had previously been drunkards. The discussion to which the rejection of the total abstainer gave rise led to the formation of the United Kingdom Temperance and General Provident Institution, of London, whose investigations later proved that abstainers were longer lived than nonabstainers.

An investigation of all the deaths of men over 60 years of age in the city of Chicago for the month of April, 1909, showed that those who had been drinkers reached an average age of 68 years, but those who had not been drinkers reached an average of over 72 years. Nineteen who had not been drinkers passed the age of 80.

Congressman Hobson states:[3]

"The figures of the British Government and English life insurance companies as to the effect of drinking on longevity are stated as follows:

"If a man at the age of 20 is a total abstainer and remains a total abstainer, his prospect of life is 44 years, and he will live to the average age of 64; but if he is a temperate regular drinker his prospect of life will be 31 years, and he will live to the average age of 51, after losing 13 years out of his life. If he is a heavy drinker, his prospect of life is 15 years, and he will die at the average age of 35, after losing 29 years out of his life. Conservative estimates place the number of confirmed drunkards in the United States at something over 1,000,000, of whom 300,000 die every year; the heavy drinkers at over 4,000,000; and temperate regular drinkers at over 20,000,000. A soldier wounded in battle and losing 10 years of his life as a consequence would be classed as seriously wounded. The confirmed drunkards and heavy drinkers together, 5,000,000 in number, must be looked upon as mortally wounded and the temperate regular drinkers as seriously wounded, making a total of over 25,000,000 Americans wounded by alcohol to-day, more than 10 times as many as wounded in all the battles of the world since the dawn of history. The estimates for the white race make over 125,000,000 white men to-day wounded by alcohol."

INSURANCE.

In view of the facts which show the relation of mortality and longevity to the use of alcohol it is not surprising that the life-insurance companies are taking up in earnest the enlightenment of the public on the subject. The Postal Life Insurance Co. issues a series of bulletins, of which No. 5[4] was entirely devoted to the subject of alcohol and mortality. I quote from this bulletin as follows:

"In 1880 the per capita consumption of alcoholic beverages in the United States was 10.08 gallons. In 1909 it reached 21.85 gallons, an increase of 117 per cent. Since 1880 the death rate in the registration States from degenerative diseases in which alcohol is conceded to be an important causative factor has increased 104 per cent."

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[1] Samuel J. Barrows, loc. cit.

[2] See Statistical Abstract of the United States of 1910, p. 544.

[3] Hon. Richmond P. Hobson, "The great destroyer," a speech delivered in the House of Representatives, Feb. 2, 1911.

[4] Apr. 1, 1911.

Bulletin No. 6,[1] of the same company, speaks again of the effects of alcohol:

"Some of the world's leading scientists—Aschaffenburg, Hodge, Laitenen, Kræpelin, and others—have shown the destructive effect of alcohol on the nervous system and its action in lowering the resistence to the bacteria of disease."

The Metropolitan Life Insurance Co., as mentioned above, publishes a bulletin called The Metropolitan. One entire issue of this bulletin, which is sent out to all the company's policy holders, was devoted to the subject of the evils of alcohol.

Many other insurance companies are issuing health bulletins, in which the use of alcohol on the part of policy holders is discouraged. I understand that out of 49 insurance companies which were circularized in regard to this subject, 39 of them replied that they did not consider even moderate drinkers good risks.

BIASED STATEMENTS.

I have tried to quote from authorities who have approached the alcohol question from a scientific point of view. It would be possible to make, with a very good show of reason, much more extreme statements, but more difficult of proof, based upon the evidence of those more or less biased by their enthusiasm.

The bias of enthusiasm, however, is not so liable to be misleading as the bias of commercial interests. I have seen much of the literature issued by brewers and distillers and have been struck by their willful perversion of the truth and the garbled quotations and misleading statements. For instance, at the great international hygiene exhibition the brewers (who were allowed to set forth their claims for beer as a "hygienic" beverage) culled certain exceptional statistics intended to show that brewers were unusually long lived. These statistics were repudiated as misleading by the statistical officer in the city to which they referred. When scientific men called this fact to the attention of the authorities of the international hygiene exhibition, they requested the brewers to remove the misleading statistics. This they refused to do and maintained that they had a legal right to keep the statistics there; whereupon the authorities of the exhibition put opposite the statistics a statement to the effect that they disclaimed any responsibility for the brewers' statistics.

One of the most interesting examples of the willful misrepresentation of facts concerning alcohol is the case of a celebrated American whisky manufacturer, who has repeatedly stated in the newspapers that whisky—or at any rate his particular brand of whisky—prolongs human life. It so happens that I visited the city where this manufacturer lives and found that both he and his son made a point of being total abstainers for the sake of their health.

POVERTY AND PROSPERITY.

Since the evidence shows that alcohol impairs labor power, it is not surprising to find poverty coexists with the excessive use of alcohol and that prosperity increases as the use of alcohol is reduced, as it has increased in Sweden, Germany, England, and in certain places in the United States. It is claimed [2] that strong drink costs England $2,000,000,000 annually and that the total amount annually spent in the United States is over $4,000,000,000.

If the conclusions we have reached—that the use of alcohol as a beverage is always a net injury and never a net benefit—these four billions annually are worse than wasted. If a direct tax of that amount were laid on the citizens of the United States they would rise in revolt. And yet such a tax would not be so heavy a burden as the expenditure for alcoholic beverages. The tax would presumably be returned, in part at least, to the public—in the form of public schools, good roads, the administration of justice, and of other governmental functions. But the expenditure for alcohol brings no return to the public and no return—except a delusive gratification—to the individual. On the contrary, it increases public and private burdens. It increases public burdens by necessitating greater expenditures for jails, police, and courts, penitentiaries, insane asylums, hospitals, and poorhouses; and it increases private burdens by impairing earning power and undermining moral character. The drinker not only robs his family of the earnings he spends on alcohol, but he robs them of the earnings he loses from unemployment due to drunkenness, from illness, accident, and other disabilities due to the use of the drug and from the resulting shortening of his life; while, further, he robs them of himself, his companionship, and personal care. If all of these disadvantages could be appraised in cash and added to the billions directly spent the total figure would probably be manyfold larger that at first appears; and the worst feature of it is that the greater part of this crushing weight rests on the

[1] Hon. Richmond P. Hobson, "The great destroyer," a speech delivered in the House of Representatives, Sept. 1, 1911.

[2] American Prohibition Yearbook, loc. cit.

shoulders least able to bear it—the shoulders of the workingman. The wealthy can better bear loss of income and efficiency, but such losses to the workman spell poverty and misery. The committee of fifty found that of the poverty which came under the notice of the charity organization societies about 25 per cent could be traced, directly or indirectly, to the use of liquor; of the poverty found in almshouses about 37 per cent.

Carroll D. Wright, formerly United States Commissioner of Labor, stated: [1]

"I have looked into a thousand homes of the working people of Europe; I do not know how many in this country. In every case, so far as my observation goes, drunkenness was at the bottom of the misery and not the industrial system or the industrial surrounding of the men and their families."

Whether or not "Prohibition Kansas" can be held responsible for all improvement in that State, it is certainly true that the State has made great strides since prohibition was introduced. The American Prohibition Yearbook states: [2]

"As a consequence of having no paupers, the poor farms of more than 50 counties have been turned into experiment stations under the control of the State Agricultural College, and are now called 'Prosperity farms.'

"In the 25 cities of Kansas the percentage of home owners is greater and the percentage of renters smaller than in the cities of any other State in the Union.

"The wealth of the State has increased at the rate of $12,000,000 per year for the last decade."

PUBLIC OPINION.

With so much evidence showing the harmfulness of alcohol, why, then, is it still consumed? The truth is, in my opinion, that the consumption of alcohol is kept up by tradition, by the assumption that so prevalent a practice must have virtues, by the fear of individuals to break away from custom, and by the well known difficulty of emancipating one's self from any drug habit. If we look at the alcohol habit squarely we see that it is merely one of the harmful drug habits—like opium in China, hasheesh in Turkey, cocaine, etc. It is a poison, and its evil effects are so great that every courageous man should help to eliminate it. Had Lincoln lived he intended, after destroying slavery, to attack alcohol. This I have on the authority of a living witness and friend of Lincoln. Lincoln is reported to have said: [2]

"The liquor traffic is a cancer in society, eating out the vitals and threatening destruction, and all attempts to regulate it will not only prove abortive, but will aggravate the evil. There must be no more attempts to regulate the cancer. It must be eradicated, not a root must be left behind; for, until this is done, all classes must continue in danger of becoming victims of strong drink."

President Taft has become a total abstainer. The Kaiser of Germany and his family have also given up the use of intoxicating liquors. On this subject, President Emeritus Charles W. Eliot, of Harvard, another recent recruit in the antialcohol column, says: [3]

"Recent researches in physiology and medicine tend strongly to show that even the moderate drinking of alcohol is inexpedient. * * * No longer are men who are to be exposed to cold, heat, fatigue, or hardships of any sort, prepared or braced for such encounters by any form of alcohol. No captain of an ocean liner ever supports himself now against the fierce exposures of the bridge by means of alcohol."

Dr. Amos P. Wilder, United States consul general, Shanghai, says: [4]

"In my journalistic and consular career I have seen so many go down—so many careers wrecked, and so much wretchedness among the innocent caused by the ignorance of those who begin the drink habit—that I must respond to any opportunity to aid in informing men, especially young men, what a dangerous thirst they are engendering. I am familiar with that confident saying in the flush of strength, 'I can take it or let it alone,' and I know the poor neglected wretch who says he wants a job, or a night's lodging, or a dollar, and finally confesses that what he wants, and must have, is a drink. One can stop and wont; the other would stop, but can't."

Physicians are beginning to give up alcohol in their practice. The marked decline in the use of alcohol as a medicine is significant of the trend of the times. It will probably soon come about that almost the only alcoholic medicines will be the outlawed "patent" or proprietary medicines containing alcohol. Dr. Mary Sturge [5] writes that an example of the decrease in the use of alcohol for medicinal purposes is shown in the treatment of fever in the British Metropolitan Asylums Board. While

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[1] What People Have Said About Whisky, by H. Parker Willis.
[2] Loc. cit.
[3] In an address to the Massachusetts No-License League, in Boston, 29th of October, 1908.
[4] In an address before the Loyal Temperance Legion, in Shanghai, Oct. 10, 1911.
[5] Quoted by George B. Wilson, loc. cit.

the number of patients has increased from 19,937 in 1894 to 27,570 in 1909, the cost of stimulants for treatment has decreased from £1,388 in 1894 to £251 in 1909. Dr. Sturge says:[1]

"The immediate deduction from these figures is that whereas up to 10 years ago alcohol was extensively used in the treatment of fevers, it is now recognized that the disadvantages attendant on its employment often outweigh any prospective advantages to be obtained from its routine application."

"Alcohol is almost entirely banished from the hospital," says George B. Wilson,[1] who further states:[1]

"In July, 1904, no fewer than 14,718 members of the medical profession petitioned the [British] Board of Education in favor of the compulsory teaching of hygiene and the nature and effects of alcohol in all public elementary schools. The promoters of this movement were the most eminent leaders of the profession, such as Sir William Broadbent, Sir Thomas Barlow, Sir Lauder Brunton, Sir Victor Horsley, and others."

The fight against alcohol is only one phase of the general fight for health and efficiency. Experience has shown that the best way to get rid of alcohol is to restore the conditions for a healthy life. The introduction of healthful outdoor sports reduces the consumption of alcohol. The evidence presented by Mr. Wilson[1] indicates that one of the most potent factors in reducing the use of alcohol has been the increased interest in athletics and out-of-door life in England. Alcohol is an abnormal craving and apparently comes from an abnormal method of living, so that the craving is diminished in proportion as normal conditions are restored. It is probable that the use of the bicycle has had some effect on the decline in the consumption of intoxicating drinks in the United Kingdom. At any rate cycling has increased at the same time that drinking has decreased.

The saloon has always been a sort of workingman's club, and has furnished amusement when few amusements which were normal and natural were available. The chief constables of York, Swansea, Gateshead, Coventry, and Airdrie, are quoted by Mr. Wilson[1] as substantiating his opinion that the growth of simple, innocent, and healthful amusements are counter attractions to the saloon and to the use of alcohol. It is his belief that the temperance reform is a permanent change in the habits of the people, due to the gradual understanding, through educational means and otherwise, of the physiological evils of alcohol and the benefits to be derived from healthier modes of recreation. Mr. Wilson says:[1]

"On April 10, 1905, the Right Hon. Austen Chamberlain, M. P., in his speech when introducing the budget, said that he thought that the decline in the consumption of intoxicants in the United Kingdom was due, in a large measure, to the growth of amusements, such as outdoor games, theaters, music halls, cheap railway excursions, etc., which were increasingly absorbing the time and the money of the people."

"Above all," says the Right Hon. John Burns, M. P.,[2] "give the people homes more homes, larger homes, cleaner homes, and sweeter homes. Abolish the slum. Raise wages. Improve the sanitation, appearance, and environment of the factories and workshops. Humanize industry—then labor will not seek degradation in drink or low company in public houses. Convert the schools into club rooms, where friendly societies and trade unions and thrift and other organizations can meet and do their business. Disestablish the public house as a house of call, divest it of all the functions, traditions, and accessories that through the ages it has taken to itself in matters of local life, civic interest, social attractiveness. Divert to the city hall, the local library, the municipal concert hall, the park, the gymnasium, and the municipal parlor, those good things which drink has craftily yoked to its chariot, then the beginning of the end of the reign of King Bung will have commenced."

[1] Quoted by George B. Wilson, loc. cit.
[2] A speech in Free Trade Hall, Oct. 31, 1904.

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